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**THE AMERICAN POTASH INSTITUTE**
**1155 16TH STREET, N. W. WASHINGTON, D. C.**

# Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

*Editorial Office:* 1155 16th Street, N. W., Washington, D. C.

VOLUME XXV NUMBER SIX

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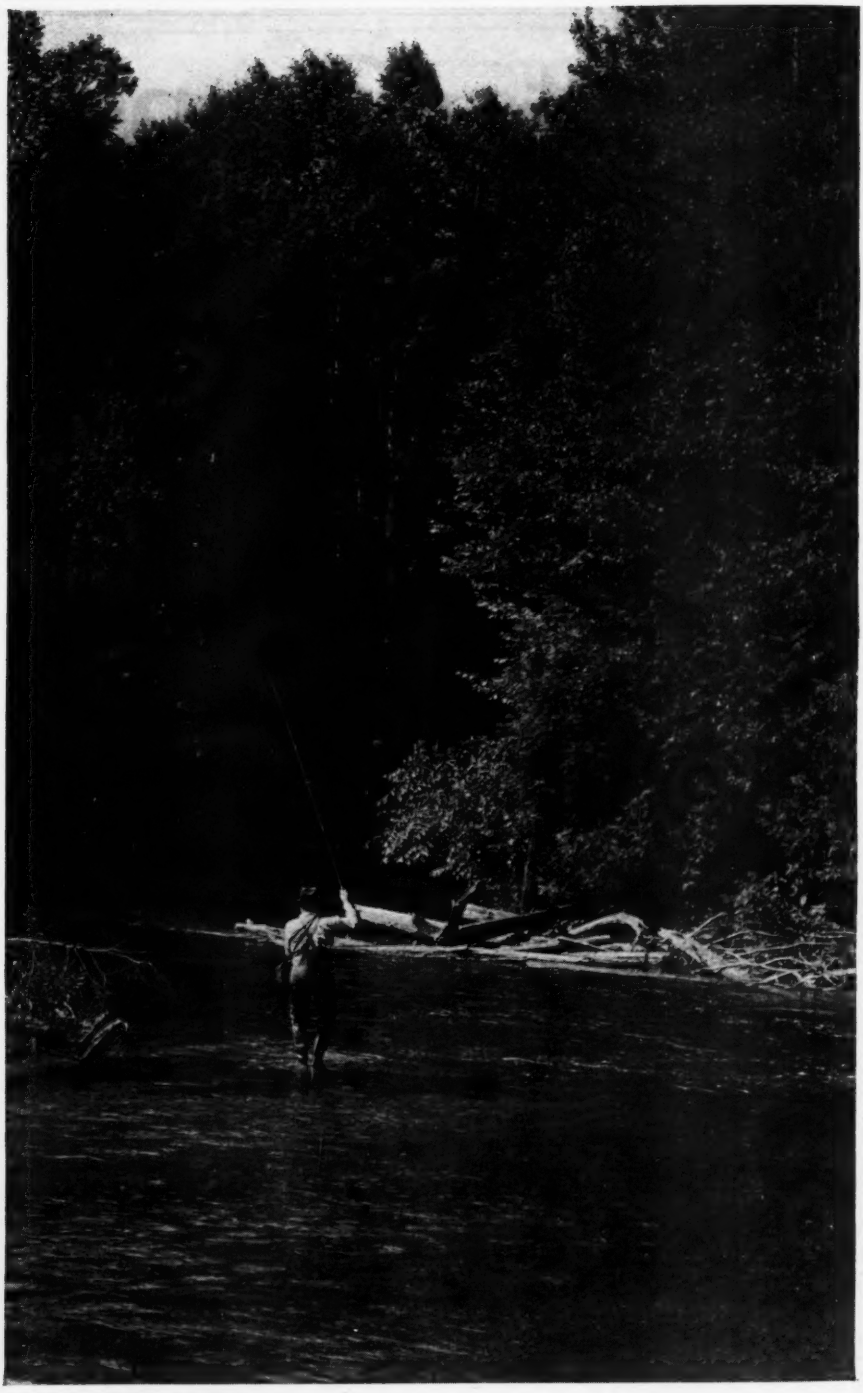

A LAST WINTER'S DREAM COME TRUE

Better Crops with PLANT FOOD

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*There is no Lack of—*

# Corncrib Loyalty

Jeff McDermid

INDUSTRY is being mobilized to beat Hitler; agriculture is being mechanized to beat Hunger; while the precious family-sized farm is being compromised to beat Hades!

And that isn't the only thing that's unsettling my mind either. War scares are bad enough without the weather taking a hand amid giddy boom plans afloat. In some parts of the country we have drenching rains and flooded furrows, and in whole sections of the East we have had parched pastures and dry river beds.

On top of that we have had some places where they complain about having more country-bred folks looking for jobs than the planters know how to take care of; while up in our bailiwick we have just the reverse, sons and brothers hiking away to the cantonments or cannon factories, leaving one tired man to do the work of three hired men (who are as scarce as peace talk in Washington).

All of which sums up to the common opinion among us yokels in the Midwest corncrib country that we can stand awhile to take a tip but we refuse to listen long to lectures. Give us all the current information as fast as the State Department or Mister Wickard's foreign service sleuths can dig it up; tell us what can be utilized quickest and safest. Tell us how to raise it, pick it, pack it, and pay for it maybe; but for gosh sakes leave out that blubber about our being behindhand in foresight and deaf to duty.

For when I scan the remnants of

what were once a set of well-painted farm houses in some of our outlying districts and think what happened to their owners who plunged too hard and bit too deep into the tempting golden apple of World War No. 1—and when I think how hard some of us worked in the original AAA to salvage some of the ruins of the other fiasco—then it makes me too turbulent to take a lecture course on democratic obligations.

It doesn't set well with chaps who get their mitts calloused doing four men's work from dawn to darkness, especially when there's a plant with communistic labor bosses thumbing their beaks at E Pluribus and all the other Unums; demanding a dollar an hour and two times two for overtime, with scented soap and initialed towels in the lavatory.

IT isn't a case of our loyalty out here either. Anybody who knows us knows that anyhow. But we don't propose to have our loyalty made into a personal liability while some other citizen shirks and turns his loyalty into personal luxury. I speak for hosts of the reputable yeomen of the silo belt. They don't seem to have the ear of these fancy columnists, so somebody has to ladle it out for them where it will be understood and do the most good.

To begin with, we of the hinterlands beyond the mountains know pretty well what it's all about, at least almost as much as some of the high-toned argufiers on the radio who have no direct burdens to bear in solving the situation. We love America because we helped to make it worth loving. Or leastwise plenty of our parent stock had a horny hand in taking it away from the Injuns, ventilating and fumigating it, and finally plastering it with mortgages during the other war boom.

We've lived so long with irksome interest and toxic taxes that we even love the banker and the assessor, because they are part of the scenery and furnish the main incentive to keep on plowing. We are just as much sold on liberty as any high-priced guy in the magazines, although not very articulate about the why and wherefore, or whether we deserve to keep it.

Yet that doesn't make us want to sit down and ruminate about it, for we hire the cattle to do that for us. We lack the stomach for ruminating, as it were. We can do better at dusting around and flaxing things up lively.

WE like to take our liberty in more natural doses. It means going fishing where the trout jump in the brooks; going cooning with trained hounds; tearing around the bases in Dad Hunker's pasture; pitching horseshoes over behind the garage; taking Nelly for a flivver ride; raising tea roses in the back garden near the turnips; and going to anybody's church with a welcome sign on it. We practice what we preach out here where liberty's roots strike deep. We prefer it to regimentation or goose-stepping and want the next generation to have its share without robbing some other fellow of his.

It's sort of bred into us like our nasal twang and our nervous temperament. Being dedicated daytimes to professional patriotism and then worrying all night about whose wolf is going to get Grandma's government—it hasn't come to that pass in our parts yet. We figure that a cuss with frazzled nerves isn't much good defending anything that deserves holding onto. We feel that the more we make love to America the more we're going to be willing to sock the first interloper who insults her. And if we fill all the waiting war orders between now and the zero hour, there's going to be ample outdoor exercise to keep us trim and tough.

If you think we can't get tough, scan the list of volunteer wars we've "fit in" since the ox teams toted us out here. We don't need any senators to egg us on, because it will take three of them to hold us back when we get started.

Neither it is a bad case of isolation with us. For history shows we sent heaps of lads to Mexico, Cuba, the

Philippines, Manila Bay, and left a few of them in the Argonne Forest too, to say nothing of Archangel and such foreign parts. Our homeopathic boxing matches have taught us the value of a long reach plus a first punch. We can drop that "ism" out of the picture entirely.

In fact, most of us refuse to wear badges with anybody's "isms" stamped on them in this crisis. We refuse to follow any upstarts who intend to make political capital out of prejudice or

ignorance. But while we keep still on those "isms" and saw wood, we would like to rear up and smite the traitors who turn liberty into license. For even free speech can get tolerably expensive.

Having disposed of isolation and loyalty dope, let's take a kink out of the charges we hear about profiteering and price-kiting by selfish corn-belt operators. They are said to be "holding up consumers with one hand and rifling the treasury with the other for benefit payments."

When I get this far my collar gets so hot it melts. If some folks would be as zealous protecting the consumer in lines other than raw foodstuffs, they might get along faster. So we can start slowly and build it up gently, and eventually like Charlie McCarthy we hope to "mow 'em down."

First off, farm labor is squeezed dry both from the draft and industrial wage offers. Take a map of the Nation and spot the intensive farming regions and then check closely and note that they are often bordered by heavy centers of munitions or machine manufacture, at least close enough to tempt away hosts of the ablest mechanics we have in agriculture. The exceptions are the deep South and part of the Midwest from Missouri through to the Rockies. But the South has a surplus of home farm help anyhow, and we are talking about the corn belt mostly.

This means that the family-sized farm has dwindled in manpower to oldsters, women, and kids. The milking machine and implement plants are doing the heaviest rush of business in two decades. Corn-belt farmers with less help are forced to buy more new machinery, some of which they would not have tackled in ordinary times because of excessive cost. Maybe some of the new machinery will permanently displace farm hands. But that's not the issue now.

NOW farmers as a whole have no basic, gilt-edged guarantee equal to that pledged to the heavy industries. The farmer makes his machinery investment on faith and hope, plus a little federal market support for awhile. In the absence of adequate protection the farmer is caught with the machinery regardless of the outcome. Unless his prices are sufficiently high to give him and the family a safe return and some spending money, the machinery will get him down, if rheumatism and lumbago don't get there first.

When machinery and other capital investment fasten themselves on a community in a broad and hitherto unheard of scale, the erstwhile owner-operators under inadequate returns may sooner or later become tenants or hired men. Then the same situation as in industrial labor obtains. Factory labor gets indifferent to the income and growth of a plant because the workers have little or no pride that comes with a slice of ownership. Maybe this is the remote cause of their following rebellious leadership. At any rate, we don't like to see it happen to any large segment of our soil workers.

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**A typical Vermont pasture where $14.55 spent for a complete fertilizer gave 1,694 pounds more milk per acre.**

# *The* Making *of* Better Pastures

*By T. H. Blow*

County Agricultural Agent, St. Johnsbury, Vermont

FIVE years of work with the agricultural conservation program and two years' land-use studies in Caledonia County, Vermont, have definitely shown problems and progress for the betterment of the hay and pasture land and the general improvement of the agriculture in the county.

Caledonia County lies in the northern part of Vermont and is sandwiched more or less by the Green Mountain range on the western side and the Connecticut River and the White Mountains on the eastern side. Being principally a hay and pasture area, the farmers find themselves in the dairy business, with the job of helping to supply fluid milk to the Boston milkshed. This area formerly produced sheep and beef cattle, but the deterioration of the pasture land necessary for heavy grazing made it impossible for the Vermont farmer to compete, on a large scale, with the Mid-western farmer who had large tracts of fertile open pasture land. The shift to the dairy business meant that the Western farmer would have the job of providing the mixed grains and dairy ration for the Eastern farmer, but it also meant that more grass per acre for hay and more grass for summer pasture would have to be produced.

In producing more hay, the Vermont farmer has done a pretty good job, but pastures have been going bad and are

continuing to get worse year after year. With a rainfall conducive to good grass farming, one of the first necessary requirements is no handicap. The county has an average rainfall of 35 inches and the heaviest of this is received during the growing season. The growing season varies from 110 days in the northern part of the county to 120 days in the southern part. The last spring frosts usually occur not later than May 22, and the first fall frosts come around September 25. Thus the dairy farmer has a natural benefit from these factors.

### Unified County Developed

For 3 or 4 years the county developed discussion meetings known as agricultural policy groups. These groups were made up of representative men and women from each town, and factors pertinent to successful farm operation were discussed and brought into the limelight. Developing out of these meetings was a unified county, in which every one of the 17 towns agreed to work toward the same goal for certain definite procedures. Town committees elected a county committee which drafted resolutions and offered them to a state and national committee. The result is that in the second year of unified county work, the following phases of educational and practical work are being carried on.

The first phase of work recommended for attention was pasture improvement. The committee felt that during the last 50 years the pastures of Caledonia County have been grazed successively year after year without the addition of any replaceable plant nutrients. This has placed a serious burden on many of the dairy farmers in that they are now forced to feed hay, grain, and green feed during the summer months in order to maintain the milk production of their herds. The old pastures, after the spring growth is over, serve mainly as an exercising ground. Today, it is quite generally recognized that pasture is the cheapest source of protein for summer milk production. Therefore, the dairyman to most efficiently produce milk during the summer months must produce that milk from pasture feed.

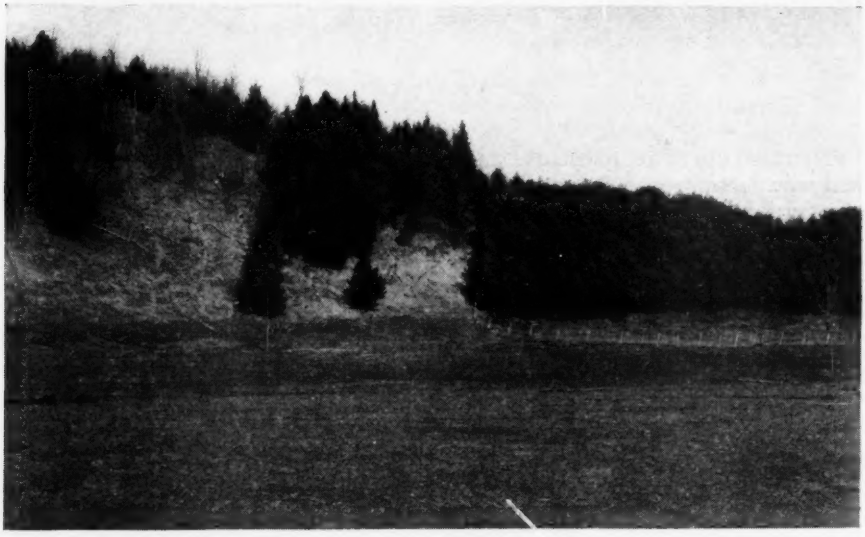
Those farmers who have followed

**A good dairy farm in Caledonia County. The tillage land in the foreground suffers severely each spring from heavy deposits of lighter soil that wash down from the once permanent pasture shown back of the buildings. Maintaining the pasture sod a few years ago could have prevented this situation.**

the pasture-improvement recommendations of the Extension Service realize the value of their pastures and are also receiving substantial returns from the money which they invested in fertilizer materials. The committee feels that the hay and crop land is in a much better state of fertility than it was five years ago because of the improvement practices that have been carried out under the Conservation Program of the Agricultural Adjustment Administration and

ing of a series of pasture fertilization and management meetings by the county agent were also made. The state and county agricultural conservation committees had already taken action to increase the payment for potash under the 1940 program.

Soil tests in Caledonia County have consistently shown a decided lack of potash not only in crop land, but in hay and pasture land as well. With the continued use of lime and phosphorus,



**Trees planted on the right some 18 years ago are holding this eroding sidehill pasture from further damage. The pasture on the left is still unprotected and will eventually wash down and destroy the tillage land in the foreground. Neither soil or trees will be left.**

very definitely feels that the pastures should be given more attention.

Among the recommendations made was one that the Agricultural Conservation Program continue to furnish lime and superphosphate as grants of aid and that they be included for any crop in the rotation except cash crops, but preferably on pasture land. It was also recommended that the payment for the old practice of a 1-2-2 ratio complete fertilizer be revived for cases where it was used on pastures. Recommendations for the setting up of pasture fertilization demonstration plots on different soil types and the conduct-

much more efficient results can and will be seen from the use of potash. Caledonia County has been the most consistent user of increased amounts of potash under the program in the State, and one has only to talk with those farmers who have used it to get a good reaction to its benefits. Each of the towns has devoted one meeting to pasture improvement, and the three important factors for better pastures would seem to be built around selection, fertilization, and management. These three go hand in hand, each being only as strong as the others make it.

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**Maximum yields of crimson clover can be produced with lime, superphosphate and potash.**

# Plant's Contents Show Its Nutrient Needs

*By Frank Moser*

Agricultural Experiment Station, Clemson, South Carolina

COASTAL Plain and Piedmont soils in southeastern United States require fertilization in order to maintain a profitable agriculture. These highly leached soils are moderately acid in reaction, low in organic matter, and low in essential plant nutrients, but by and large respond very favorably to proper fertilization. Much attention has been given by research workers to the development of suitable indices for estimating available soil nutrients in order to make as correct a recommendation as possible for fertilizer application for crop production.

Field and pot tests have been the most widely accepted methods for determining fertilizer responses, but were most applicable to respective crops on similar soil types; whereas plant analyses have also been emphasized since the work of Wolff, who clearly demonstrated that plant composition was affected by the nutrient content of the growing medium. More recently rapid chemical tests have come into prominence and are considered by most agronomists as supplemental aids for making fertilizer recommendations, as such tests must ultimately be interpreted in terms of crop yields.

The present tendency is gradually turning to the plant for more definite information as to its nutrient needs. Foliar diagnoses, either as deficiency symptoms or as chemical analyses of dominant nutritive elements in the leaf, have become suitable aids for plant

scientists and are considered most valuable when used with definite keys of interpretation. A more practical basis for studying nutritional requirements may be obtained from the plant itself by determining the percentage composition at its maximum growth for such critical nutrients as calcium, phosphorus, and potassium. The amounts of fertilizer material corresponding to such plant analyses can be computed and applied for growth of the respective crop.

Fertilizer recommendations based on plant-food content of crops have been used with much success in old-farming countries of Europe, and since the soils of the Southeast are some of the oldest in the United States, such methods should be applicable to these lateritic soils because they have been thoroughly depleted of their native fertility by erosion and continuous cropping. Consequently, many lateritic soil types have a low productivity rating and many common soil characteristics which necessarily require similar fertilization for identical crops regardless of the soil type.

### Numerous Questions Arise

Soil conservation and the much publicized diversification programs recommended for the Southeast have caused a shift from the usual acid-tolerant crops, as corn and cotton, to more close growing ones. Certain legumes have been widely advocated for this section without sufficient attention given to their ecological adaptation. As a result numerous questions have arisen relative to their optimum fertility needs and to what extent either fertilizer or lime can compensate for the changed soil and climatic factors. Experiments were conducted with lespedeza, crimson clover, and winter peas to determine optimum growth by growing these crops at varied pH and fertility levels, while the harvested portions of the plants were analyzed for certain critical elements to determine the nutrient absorption.

That calcium is undoubtedly a limiting element for crop production was exemplified by a recent summary of pH values for South Carolina soils which classified approximately 80 per cent from extremely to moderately acid having pH values ranging from 4.0 to 6.0. The available supply of soil calcium appears to be directly proportional to the pH values since with increasing pH the replaceable calcium content of Cecil sandy loam soil becomes significantly higher as the reaction approaches neutrality.

Additional evidence accumulated for lespedeza emphasizes the importance of calcium for growth in spite of the fact that this crop has been so widely advocated as an acid-tolerant legume. The yields for lespedeza hay show that the optimum pH range for growth was from 6.0 to 6.5 which produced a maximum yield of 40.9 grams per pot. A much lower yield of 29.3 grams was secured at pH 4.5, while 38.9 grams and 39.4 grams were the yields produced at pH values of 5.5 and 7.5, respectively.

Plant composition indicated marked differences in calcium absorption by plants at the various pH ranges and showed that the increased calcium supply of soil resulting from the addition of calcium hydroxide for pH adjustment was reflected in the calcium content of the plant since an increase from 0.88 per cent to 1.28 per cent occurred where the replaceable calcium was varied from 300 pounds per acre to 1,340 pounds. The corresponding pH change was from 4.5 to 7.5. Further increases in calcium content were obtained at each pH level, results from the addition of superphosphate suggesting that soluble phosphates were very beneficial in the absorption of calcium and phosphate ions. Doubling the superphosphate application gave the highest percentage calcium, whereas superphosphate and potash were not as effective in increasing plant calcium, which was probably due to the competition of the phosphate and chloride ions. The chloride and potassium ions, being more readily absorbed, naturally reduced the calcium and phosphate absorption and lowered the percentage of these ions within the plant.

The chemical analysis of lespedeza shows that the phosphorus content was not appreciably affected by the higher pH values, these producing an absolute variation of 0.04 per cent or 30 per cent on a comparative basis. However, total phosphorus absorption was markedly increased on those pots receiving superphosphate. At the lowest pH the phosphorus absorption was increased by fertilization from 13 to 21 pounds per acre, while at the optimum pH an increase from 21 to 36 pounds was obtained. The superphosphate and potash treatment resulted in lowering the absorption at the optimum pH range, the phosphorus being increased from only 21 to 26 pounds.

The potassium content was least affected, being approximately the same at pH value from 5.0 to 7.5. Superphosphate applications caused an increased potassium absorption from 62 to 88 pounds per acre, while the same amount of superphosphate along with potash fertilizer increased the potassium content from 62 to 120 pounds.

The data accumulated for lespedeza at optimum growing conditions are presented in Table 1. The data suggest that high yields and optimum nutrient absorption usually occur simultaneously, whereas luxury consumption of nutrients will result where excessive amounts of available nutrients are provided for plant absorption.

The results also show that lespedeza is most responsive to the higher fertility levels and to only slightly acid soils. Phosphate fertilizers appear to be very important as the oven-dry weight of lespedeza hay was significantly higher, at all pH levels, on the pots where superphosphate was applied, than on pots receiving no phosphate. This beneficial effect was especially noticeable at the lower pH level where the yield was increased from 29.3 grams to 40 grams per pot. It was probably due to the fact that superphosphate inactivated the soluble aluminum as well as supplied available phosphate and in that way was beneficial in offsetting the deleterious effects of low pH values.

These data in Table 1 propose that lespedeza requires an approximate pH value of 6.0 for optimum growth and further suggest that a nutrient requirement corresponding to 175 pounds of

(*Turn to page* 39)

**Even lespedeza is most responsive to the higher fertility levels. To provide a good cover for erosion control, phosphorus and potash fertilizer along with a small application of dolomitic limestone will assure good growth of lespedeza.**

# Basing a Program on What the Soil Tells

*By F. G. Hall*

County Agricultural Agent, Findlay, Ohio

THAT Hancock County, Ohio, believes in signs is borne out by the results of soil testing during the past few years. In 1935 a series of tests were made in cooperation with the Soils Testing Service at Ohio State University, and each year since the work has been repeated either by holding clinics at the High Schools in the county through the use of a portable laboratory, or the collection of samples for testing at Ohio State laboratory.

Soil has been tested and recommendations prepared on the use of lime and fertilizer for 495 farmers. The tests cover 991 separate fields and represent approximately 2,700 separate soil samples. Analysis of all samples shows an average pH of 6.4. Eighty per cent of the samples are "Very High" or "High" in active calcium. Seventy-seven per cent are "Low" to "Very Low" in phosphorus. Ninety-one per cent are "Low" to "Very Low" in potash.

The first conclusion derived from reading those signs was that potash was certainly deficient on most of the soils of the county. Acting on that conclusion, more potash was talked. At the same time the indicated shortage of phosphorus and the fact that lime was needed on the light colored soils of the county, which constitute about 65 per cent of the crop land area, were pointed out. About a ton of lime was needed per acre to correct acidity and grow good crops of legumes.

While the following figures do not show total lime consumption, they do accurately show a trend toward the use of more lime. The lime companies report lime sales to the Ohio State University soils department. Such sales are reported below:

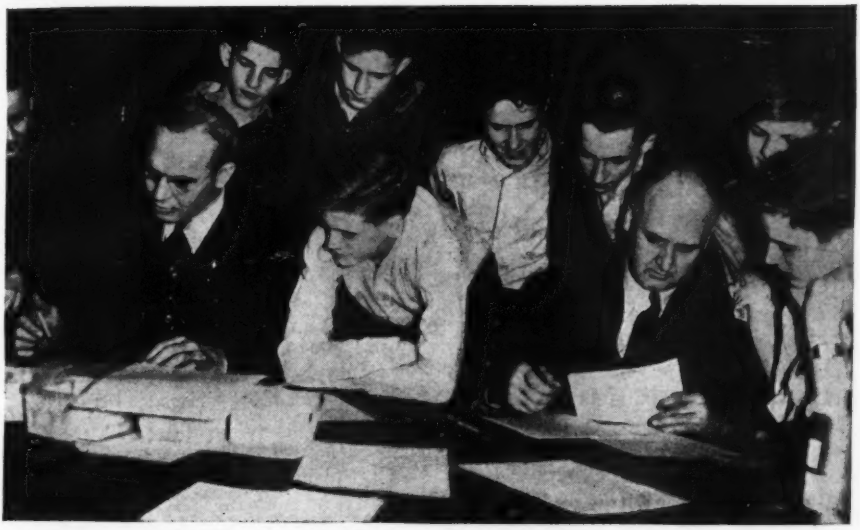
| *Period* | *Tons Sold* | *Years Reporting* |
|---|---|---|
| 1920–1924..... | 31 | 1923–24 only |
| 1925–1929..... | 555 | 1925–27–28–29 |
| 1930–1934..... | 285 | 5 years complete |
| 1935–1939..... | 1,331 | 5 years complete |

In order that speedy, consistent recommendations might be made for the use of lime, the following table was prepared. The recommendations are based on ground agricultural limestone with a screen test of 40 to 60 per cent through a 100-mesh screen. When screenings are used the rate of application is doubled.

LIME REQUIREMENTS WHEN SOIL IS
*Light Yellow - Clover Fair*

| and the Reaction is | and the Active Calcium is | then the Lime Recommendations are |
|---|---|---|
| | | (lb. per A.) |
| pH 4.0–4.9.... | VH–H | 2,000 |
| | M | 3,000 |
| | L–VL | 4,000 |
| pH 5.0–5.9.... | VH–H | 2,000 |
| | M | 3,000 |
| | L–VL | 4,000 |
| | VH–H | 500 |
| pH 6.0–up..... | M | 1,000 |
| | L–VL | 2,000 |

Similar tables have been prepared with relative amounts of lime for: Light Yellow — Clover Good, Brown Dominant — Clover Fair, Brown Dom-



**Soil clinic at Arcadia High School. County Agent Forest G. Hall (left) and Extension Specialist J. A. Slipher (right) show a group of vocational agriculture students the how and why of soil testing.**

inant — Clover Good, Gray — Clover Fair, Gray — Clover Good.

The signs relative to fertilizer pointed in many directions, soil type, crop to be grown, former treatment, manure available, and reaction from soil test itself. In order to simplify the system somewhat, certain crops were first indicated. Phosphorus shortage being generally recognized as a deficiency led to the use of the phosphorus reaction as basic. Subdivisions were then indicated for potash, and a table similar to the one on lime prepared. Below is a sample as worked out for wheat to be followed with clover. Other crops, corn, truck, alfalfa, etc., are covered by similar tables. The reactions are reported on the basis of availability, "Very High," "High," "Medium," "Low" to "Very Low."

With 77 per cent of the tests showing "Low" to "Very Low" on phosphorus,

**Close-up of sugar beets on the E. L. Thomas farm, Findlay, Ohio. Beets on left received no fertilizer, while those on the right received 200 lbs. of 2-8-10.**

CROP - WHEAT FOLLOWED BY CLOVER

| Phosphorus Reaction | Potash Reaction | Fertilizer Recommendations | |
|---|---|---|---|
| | | Pounds per Acre | Analysis |
| VH–H..... | VH–H | ... | ..... |
| | M | 200 | 0–14–6 |
| | L–VL | 200 | 0–10–20 |
| M..... | VH–H | 250 | 0–20–0 |
| | M | 250 | 0–14–6 |
| | L–VL | 250 | 0–10–10 |
| L-VL..... | VH–H | 250 | 0–20–0 |
| | M | 250 | 0–14–6 |
| | L–VL | 300 | 0–10–10 |

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# A Balanced Diet For Nursery Stock

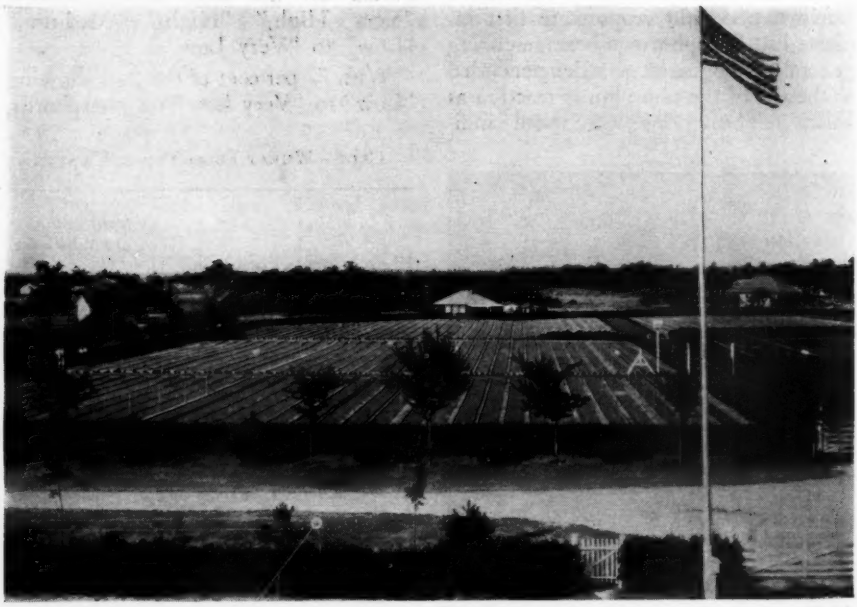
*By S. A. Wilde*

Agricultural Experiment Station, Madison, Wisconsin

THE question, "Will it pay to apply fertilizer?", is one that does not bother a nursery manager. The value of the crop produced on one acre of seedbeds varies from $5,000 to $10,000, and the cost of the fertilizers constitutes but a small fraction of the total expense. The reason why some nurserymen are reluctant to use commercial fertilizers lies elsewhere.

Until recently there has been little reliable knowledge of the nutrient requirements of different tree and shrub species. The application of fertilizers in nurseries is a rather delicate operation which, if conducted unskillfully, may injure germinating seedlings by salts in solution or may encourage damping-off and root-rot diseases. The increase in the size and weight of seedlings caused by fertilization does not necessarily mean an improvement in the quality of planting stock, as its vigor may be lowered by unsatisfactory root-top ratio, succulent tissue, and inferior physiological make-up.

The complications involved in the problem of nursery soils fertilization have been considerably increased by a number of misconceptions introduced by the early students of silviculture. Some of the theories advanced dis-



**General view of a modern forest nursery.**

**An example of well situated and adequately protected nursery beds.**

counted the importance of nutrients for the growth of trees, and others refused to acknowledge the beneficial effect of fertilizers, particularly mineral salts. These ideas were carried so far that some European nurseries advertised starving seedlings raised on infertile soils as especially well suited to reforestation.

The prejudice against mineral fertilizers had developed chiefly because of the failure of silvicultural experiments designed with an insufficient knowledge of soil chemistry. An unsuitable reaction of the soil, deficiency of buffering colloids, ineffectual one-sided fertilization, disruption of nutrient balance, high carbon-nitrogen ratio, and fixation by the soil were commonly overlooked, so one or more of these adverse conditions was responsible for the failure of fertilizer treatments.

The assumption that trees are not dependent upon mineral plant food had a much more involved background. Observations of the fact that highly productive forest stands are often found on soils with a low content of nutrients were misinterpreted to mean that seedlings needed little nutrients.

Large trees are able to utilize nutrients from an enormous volume of soil. They can make use of difficultly soluble minerals and protein compounds; they store plant food in their leaves and return it to the soil as leaf litter. In these ways a forest not only maintains the fertility of the soil, but over a long period converts barren wastes into productive land. Nursery stock, on the other hand, is raised at a great density; its roots seldom penetrate below a 10-inch depth; no crop residues are left in the soil of the nursery because even the root systems are removed. Under such conditions the maintenance of a satisfactory fertility level in nursery soils requires applications of fertilizers at a much higher rate than is common in farming practice.

How to solve the task of nursery soils fertilization with all its complicated aspects? How to establish a balanced diet for various tree species which would produce morphologically and physiologically vigorous planting stock?

These were questions to be answered.

In the earlier days of soil investigations there was only one way to study the balance of nutrients, i.e., by empirical greenhouse and sample plat trials. Such purely inductive methods proved to be of little value in studying the variable and mutually interrelated factors of nursery soil fertility.

### Virgin Soils Analyzed

The recent progress in analytical determinations of soil reaction, exchange properties, and available nutrients, however, enabled the use of a much more fruitful deductive approach, namely the analysis of virgin soils under productive stands of various tree species. The statistical data derived from analyses of such natural seedbeds give the closest approach to the physiological optimum of growth conditions. Such data provide not only the amount of nutrients, which may be somewhat variable, but the constant ratio of various constituents, which is the chief prerequisite to balanced nutrition of seedlings. As experience in nurseries and greenhouses has shown, the natural fertility levels help to prevent both the starvation of nursery stock and the unreasonably rapid growth and abnormal one-sided development.

In the course of the past five years, the Wisconsin Soils Department has analyzed several thousand soil samples collected under productive stands of representative species throughout the Lake States region. The average values obtained by means of statistical treatment of the results are presented in round numbers in the accompanying table and are suggested as the standards for the maintenance of nursery soil fertility. The $N\text{-}P_2O_5\text{-}K_2O$ ratio of available nutrients approaches 1-2-5 for all conifers and yellow birch, and 1-3-5 for the remainder of the hardwoods studied.

The use of the suggested standards has been tested with satisfactory results in the forest nurseries of Wisconsin and several neighboring states. Field-planting experiments conducted by the Wisconsin Conservation Department in cooperation with the University have shown a higher survival and more rapid growth of planting stock

(*Turn to page* 40)

STANDARDS OF FERTILITY FOR NURSERY BLOCKS RAISING DIFFERENT SPECIES OF TREES

| Species | Reaction pH | Base exchange capacity m.e./100 gm. | Total N per cent | Approximate level of avail. N | Available $P^2O^5$ | Available $K^2O$ | Replaceable Ca |
|---|---|---|---|---|---|---|---|
| | | | | Pounds per acre | | | |
| Jack Pine | 5.6 | 5.0 | 0.10 | 20 | 40 | 100 | 1000 |
| Red Pine<br>Scotch Pine* | 5.4 | 8.0 | .12 | 30 | 50 | 150 | 1500 |
| White Pine | 5.4 | 10.0 | .14 | 35 | 80 | 200 | 2500 |
| White Spruce<br>Norway Spruce* | 5.2 | 15.0 | .25 | 45 | 100 | 250 | 3000 |
| Yellow Birch | 5.3 | 12.0 | .16 | 35 | 60 | 175 | 2000 |
| Hard Maple<br>Am. Elm, Basswood | 5.8 | 14.0 | .20 | 45 | 150 | 275 | 3500 |
| White Ash | 6.2 | 16.0 | .22 | 55 | 185 | 300 | 4500 |

* Standards extended on the basis of practical nursery experience.

# BORON—

## *a Minor Plant Nutrient of Major Importance*

*By W. L. Powers*

Oregon State College, Corvallis, Oregon

DURING the past two decades replacement of animal power by farm tractors, introduction of pure synthetic fertilizers, and intensive specialized agriculture on leachy, humid-climate soils have contributed to manifestation of numerous deficiency diseases of crop plants. Part of the boron, sulphur, and iodine may have been roasted out of the basaltic lava from whence came the major soil-forming material in the Pacific Northwest.

During the past 25 years the essential nature of very small amounts of several of the so-called minor or trace elements has gradually become apparent. Various obscure types of malnutrition in plants are prevented or corrected by the presence of traces of such elements as boron, manganese, zinc, copper, molybdenum, or other elements for which essentiality is less definitely established.

For 12 years the Soils Department of the Oregon Experiment Station has done exploratory work with minor elements on Oregon soils, including an intensive study of the need and value of iodine, followed by boron and recently by manganese investigations. Striking improvement in vigor and yield has been secured from the use of boron on leached soils. Use of boron as a fertilizer for alfalfa west of the Cascade Mountains promises to be as profitable as sulphur has been on the more arid basaltic soils to the east. In former reports (Powers, 1937, 1939) (Powers and Bouquet, 1939) the earlier studies with boron in relation to soil fertility in the Pacific Northwest or Columbia Basin were reviewed. The purpose herein is to present a progress report covering continued and recent boron experiments, particularly in Oregon and the Pacific Northwest.

Evidence of the essentiality of boron as plant food was reported by Agulhon (1910) and Maze (1919) and confirmed by Warington (1923) and Sommer and Lipman (1926). The latter grew large numbers of plants in solution cultures built up from purified chemicals in redistilled water and from successive generations of seed. According to Purvis (1939), 24 states have reported boron-deficient areas, and no plant nutrient has received so much notice in recent literature. Boron, like most of the trace elements, is helpful only at concentrations of the order of one-fourth part per million. Two parts per million in solution may be toxic, so great care is needed in its use. An excess leads to spotting, discoloration, and defoliation of lower leaves, while a deficiency causes bronzing, then yellowing or blighting of terminal growth.

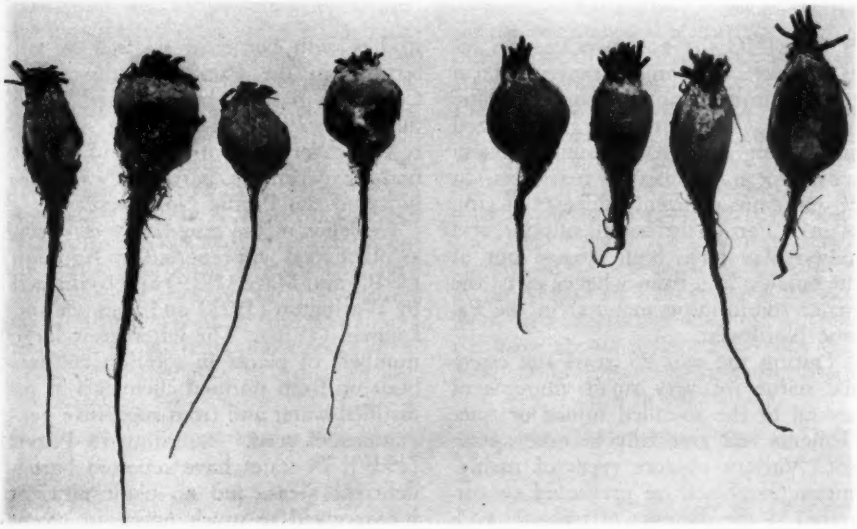
### Boron As a Control

A score of plant malnutritional symptoms have been related to boron deficiency. Boron has been used in the Columbia drainage area to control "corky core" and "drought spot" in apples, "yellow top" in alfalfa, celery "stem crack", turnip "brown heart", discoloration of broccoli and asters, and

"growth strain" of potatoes. Frequently, marked increase in yield and quality resulted from the treatment.

Boric acid was used by the writer to correct a certain type of chlorosis in water-culture experiments as early as 1926. Alfalfa grown in the greenhouse in 2-gallon jars of Springdale and Mission soils from Stevens County, Washington, in 1936 developed yellow top before the third cutting. Two hundred cc of solution containing one part per million of boric acid corrected this in a few days. The yellow top reappeared as the plants approached maturity for the fifth cutting. Boron promoted blooming and branching of alfalfa and should aid longevity. Similar response was obtained the same season in British Columbia by McLarty (1936).

Good control of beet canker was secured, perhaps for the first time, with 30 pounds of borax an acre in experiments started by Powers and Bouquet in 1937. Celery stem crack has been controlled by use of 20 pounds of borax an acre the past 4 years in experiments in cooperation with Professor A. G. B. Bouquet. Little leaf of stone fruits near The Dalles was controlled more completely when borax was included with the zinc spray. Boron is now rather generally used in the Hood River Valley to control corky core, following results of McLarty (1936). Potato growth strain and cauliflower discoloration have been corrected in Oregon experiments. Chemical determinations show unfavorably low boron content in soils, waters, and vegetation in affected areas. Use of boron in such areas has increased the boron content of plants and raised the chlorophyl and the vitamin A contents as much as 50 per cent. Standards are being developed for boron content of normal leaves.



**Beets grown in 1936 on Newberg loam. Those on the left show canker, while those on the right received 30 pounds of borax an acre, which gave commercial control of canker.**

Boron appears to give elasticity to the plant cell membranes and to aid cell division (Johnson and Dore, 1929). It seems to regulate respiration, lessen effect of drought, has improved keeping quality of apples and prunes (Roberts, 1940), and prevents swelling and blocking of roots (Sommer and Sorokin, 1928) and pollen tubes (Denis and O'Brien, 1937). Boron prevents breakdown of conduction tissues (Warington, 1923), is important in nitrogen metabolism, and aids development of

nodules and nodule bacteria (Brenchley and Thornton, 1925). Boron affects carbohydrate translocation (Johnson and Dore, 1929) and pectin formation and amount of calcium in tissues. Eaton (1940) reported boron to be essential to formation of auxin in plants, and Goldsmidt and Peters (1932) reported it essential in metabolism of brown algae. Boron is a constituent of animal tissues (Bertrand, 1912).

### Major Field Trials

Results of major field trials with boron for alfalfa and clover and grass are summarized in Table 1. Thirty-six trials have been conducted on 24 crops and 20 soil types including 236 plots. Also, material has been furnished the past 2 years to 24 county agents for demonstration tests. Use of boron in the Great Basin and in southern Oregon has been ineffective, and in field trials control of beet canker has not affected total yield very consistently. Increase in alfalfa yields has been as large as two tons an acre per season. A single application of 40 pounds of boric acid an acre on Willamette loam at the Hagg brothers' farm gave a total increase in yield of some 5 tons alfalfa, and yellow top has not reappeared after 3½ years. The increased yield occurs particularly with old meadows and dry-weather cuttings. Legume crops are relatively good indicators of boron need. Bountiful beans in the greenhouse make quick growth and yield goodly amounts of leaves, stems, and pods. (*Turn to page* 36)

TABLE 1—CROP RESPONSE OF ALFALFA TO BORON ON OREGON SOILS. SOILS DEPARTMENT, O. S. C. EXPERIMENT STATION, 1937 TO 1940 INCLUSIVE

| Soil | Kind of treatment | Rate per acre | Duration of test | Yield | | Gain or loss | Net profit over cost of treatment |
|---|---|---|---|---|---|---|---|
| | | | | Plus boron | No boron | | |
| | | Lb. | Years | Tons | Tons | Tons | $ |
| Willamette silty clay loam... | Boric acid | 10 | 4 | 3.31 | 2.90 | .41 | 2.78 |
| | Boric acid | 20 | 4 | 4.03 | 2.90 | 1.13 | 8.04 |
| | Boric acid | 30 | 4 | 4.88 | 2.90 | 1.98 | 14.34 |
| Willamette loam..... | Boric acid | 20 | 4 | 4.35 | 3.84 | .51 | 3.08 |
| | Borax | 30 | 4 | 4.49 | 3.84 | .65 | 4.22 |
| Willamette loam..... | Boric acid | 40 | 4 | 4.88 | 2.83 | 2.05 | 14.40 |
| | Borax | 30 | 3 | 4.29 | 2.83 | 1.46 | 10.70 |
| Willamette silt loam..... | Borax | 25 | 1 | 4.32 | 3.27 | 1.05 | 7.58 |
| Amity silty clay loam..... | Boric acid | 10 | 2 | 4.10 | 3.73 | .37 | 2.46 |
| | Boric acid | 20 | 2 | 3.78 | 3.73 | .05 | −.60 |
| | Boric acid | 30 | 2 | 4.30 | 3.73 | .57 | 3.06 |
| | Borax | 15 | 2 | 3.52 | 3.73 | −.21 | −2.17 |
| | Borax | 30 | 2 | 4.18 | 3.73 | .45 | 2.62 |
| | Borax | 45 | 2 | 4.67 | 3.73 | .94 | 6.05 |
| | Borax + Superphos | 30 + 300 | 2 | 3.43 | 3.73 | −.30 | −3.38 |
| | Borax + Boric acid | 40 + 40 | 4 | 3.90 | 3.73 | .17 | −.29 |
| Salkum gravelly clay loam... | Boric acid | 20 | 2 | 2.88 | 1.24 | 1.64 | 12.12 |
| loam..... | Borax | 20 | 2 | 9.71 | 9.27 | .45 | 2.95 |
| Wapato silty clay loam*.... | Borax | 30 | 1 | 2.27 | 1.81 | .46 | 2.70 |
| Salem gravelly loam*..... | Borax | 30 | 2 | 2.80 | 2.71 | .09 | −.26 |

* Clover and grass.

# The Concept of 'Available" Nutrients In the Soil

*By S. R. Dickman*

Soil Chemist, Agricultural Experiment Station, Urbana, Illinois

SINCE the days when van Helmont and Glauber were searching for the "principle of vegetation," agricultural workers have studied the question, "Why and by what methods do plants grow and develop?" DeSaussure was among the first to recognize that the mineral elements were essential to plant growth, and his conclusions were later confirmed by the work of Boussingault, Liebig, Lawes, Gilbert, and many others. Once the importance of soil minerals became recognized, chemists began to experiment with methods of measuring them. A vast number of total analyses of different soils were made, yet the general correlation between the total amount of an element and crop response to an added fertilizer was very low.

A more selective technique was published by Daubeny in 1845 (8) in which he proposed to separate the "active" from the "dormant" mineral constituents of soils. His paper might be cited as the beginning of the "modern" era in soil fertility, for since that time agricultural workers have continued the search for rapid, accurate procedures which will yield information about the fertility of a given soil and its need for fertilizers. Although the methods have changed considerably with the passage of years, the terminology and basic concepts underlying the work have altered surprisingly little. The object of this paper is to examine present viewpoints in relation to those of the past and to offer a few suggestions that may possibly be of use in the future.

Although Liebig, Knop, and others were concerned with the status of nutrients in the soil, the first well-recognized attempt to measure chemically those portions of the soil phosphorus and potassium that were immediately available to plants was made by Dyer in 1894 (10). Phosphorus and potassium soluble in one per cent citric acid under the conditions of the extraction he called the "available phosphorus" and "available potassium" respectively. Tollens (13) and Stutzer (18) had previously used citric acid in the examination of manures, but Dyer was the first to suggest that it measured the available phosphorus and potassium in soils. In his two papers (10, 11) he gave the results secured by this method on many of the Rothamsted plots and showed that there was a correlation between the quantity of these elements extracted, the fertilizer treatment, and crop yields.

It is now generally agreed that the theoretical basis of Dyer's selection of one per cent citric acid was incorrect, and Russell and Prescott (16) have further pointed out that the amount of phosphorus in the acid extract does not represent any single form of phosphorus, but is the equilibrium resultant of two opposing factors: (1) the quantity of phosphorus dissolved from the soil by the acid, and (2) the quantity so liberated that is adsorbed by the soil.

A citric acid extract contains more phosphorus in a given experiment than comparable normalities of hydrochloric acid or nitric acid, not because it dissolves more phosphorus, but because the readsorption is less. They continue, "Thus it is incorrect to call the net amount brought out the 'available $P_2O_5$' as if it were something real in the soil; it is simply an analytical result, which will vary when the conditions of the treatment are varied." This criticism of Dyer's work seems to have been generally overlooked by many soils workers, and the trend in soil chemistry for some years was to imitate root action in the determination of the "available nutrients."

### Results of Investigations

In 1909 G. S. Fraps (12) published the results of his thorough investigations in the use of N/5 $HNO_3$ as an extracting agent for phosphorus. Fraps, too, recognized that the acid extraction did not measure a definite form of phosphorus in the soil. He further stated, "Soils may contain equal quantities of phosphoric acid soluble in N/5 $HNO_3$ and yet give unequal quantities of phosphoric acid to plants on account of differences in the phosphate present. Only those soils should be compared which probably contain the same kinds of phosphates. Two soils might expose the same amount of the same kind of phosphate to the plant roots and yet give up very different amounts to an acid solvent, or they might expose different amounts and yet give up nearly the same quantities."

Comber (7) was among the first to realize that the solubility of a fertilizer or soil constituent does not wholly determine its availability, and further suggested that soil colloids and root colloids form one system. Casale (6) postulated a type of exchange mechanism whereby the ions are transferred from soil colloid to root colloid. This mechanism has been recently studied intensively by Jenny and co-workers (14) and must be considered as one of the factors which influence nutrient uptake by plants.

The estimation of the phosphate most closely concerned with plant growth received added impetus in 1929 and 1930 with the publication of "A Field Test for Available Phosphorus in Soils" by R. H. Bray (1) and "The Determination of the Readily Available Phosphorus of Soils" by E. Truog (19). These papers simplified the technique of measuring phosphates and have been widely used during the past decade. Truog attempted to simulate plant feeding by employing a dilute acid, and furthermore implied strongly that the method distinguished two separate and distinct kinds of soil phosphates which he designated as "readily available" and "difficultly available." To the extent that dilute sulfuric acid, or any acid solution, separates two or more chemical forms of soil phosphates, Truog is justified in setting up differences in their availability to plants; but it must not be forgotten that any acid-extraction method is subject to the factors mentioned by Fraps and by Russell and Prescott. A separation of soil phosphates into classes on the basis of an acid extraction is simply not justified by the facts of crop response. In Illinois a number of soils which test "high" in "available" phosphate by Truog's method still exhibit a definite response to added phosphate as superphosphate for wheat.

### A Matter of Definition

It is but a matter of definition to say that the readily available phosphorus has a higher availability than the difficultly available or any other form of soil phosphorus, yet all data that bear on this question show that the acid-extractable phosphorus does not represent any one chemical form of soil phosphorus. The forms contributing to a "high" test in one soil may have an availability very different from those contributing to a "high" test in another soil.

In still another way a classification of soil phosphates into "readily avail-

able" and "difficultly available" is poorly chosen because sharp, definite, chemical distinctions cannot be discussed within its framework. It ignores the present and future chemical methods on which an eventual solution of the soil phosphate problem must be based. By this is meant that the above classification is inelastic and non-extensible. On the other hand, a classification of each form of phosphate in terms of its chemical structure can be extended as long as new forms are discovered. The necessary experiments to determine the absorbability of each form can then be carried out.

The footnote by Bray in Illinois Bulletin 337, in which he explains that "available phosphorus" has been used for want of a better term and whenever used in that bulletin means only that phosphorus detected by the test seems to have been generally overlooked by most soils workers. As a consequence of this failure to understand his use of the term, the field test of Bray has been adversely criticized when it did not determine the "available" phosphorus in other states with soils, crops, climate, etc., differing widely from those in Illinois.

### Definition Lacking

Even though the terms, "the available nutrients," or in the older literature, "the available plant food," occur very often in soils literature, a thorough search through many publications has failed to reveal a single satisfactory definition of them. The soil chemistry commission which met in Munich in 1914 agreed to "use the term 'available' only in cases where plant physiological evidence proves the availability of the concerned plant food in soils" (9). It is evident that this statement is neither a definition nor a description.

A recent attempt to define "available" has been made by Spencer and Stewart (17). They discuss the various ways in which available is used, and conclude that "all the factors operating to insure the presence of assimilable nutrient in the plant's zone of absorption" is the best use of the term. Still, their definition of available, "possessing both chemical and positional availability; implying the satisfactory condition of *all* the factors necessary to insure the assimilation of the nutrient by the plant," not only is a circular type definition but would make an analysis of the plant ash after the crop had grown the measure of the amount of an available nutrient.

Mitscherlich's (15) use of "available nutrient" in the mathematical treatment of the nutrient-fertility problem is probably one of the causes of the controversy concerning his work. The evaluation of experiments with fertilizers consistent with the view adopted in this paper will be developed in a subsequent article.

What operations are there by which we can determine if a substance is available or not? An analogy may help to clarify the point. If a hungry man with only a nickel enters a cafeteria, is the amount of "available food" the same for him as for another hungry man with a dollar? No matter if we answer yes or no to the above question, we should be able to justify our answer logically by the use of some operation or method of measurement. It is the writer's judgment that a relationship exists between the food in the cafeteria and a particular person there and that this relationship can best be expressed by the quantity of food actually eaten by the individual. This amount would be an expression of the availability of the food to the individual. A similar relationship exists between the plant and the soil. Plants differ with respect to their ability to utilize the ions in the soil, and analysis of the plant ash serves as a measure of the availability of a particular ion when no other ion has limited absorption.

The striking advances in some fields of the physical sciences in recent years are the direct result of a new viewpoint and method of attack by physical scientists toward their problems. In physics this point of view has resulted in the

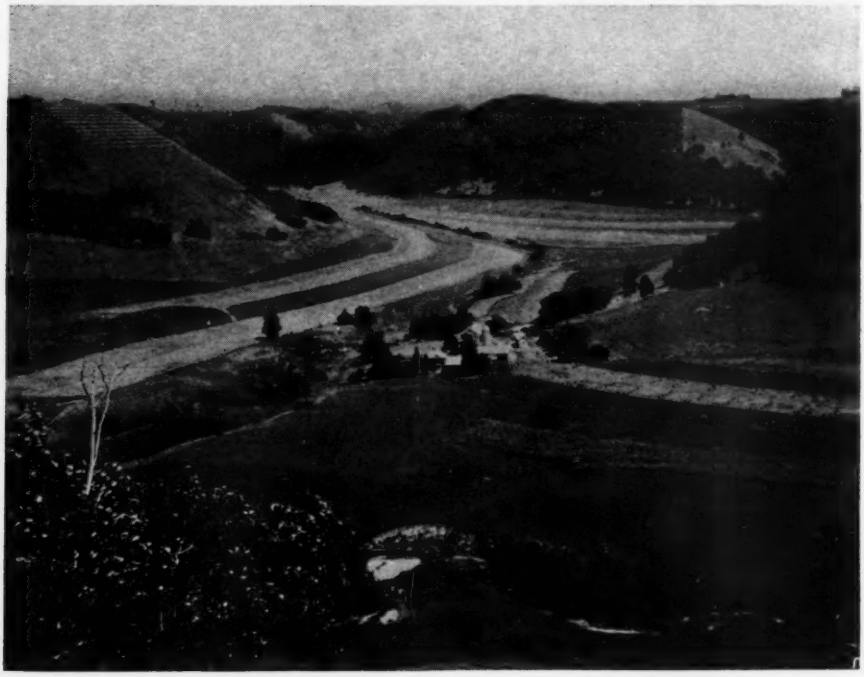
(*Turn to page* 42)

# PICTORIAL

FISHING IS AN IMPORTANT SOURCE OF FOOD AND RECREATION TO COLORED FOLKS OF THE SOUTHEAST.

Above: Haying on permanent alfalfa and sweet clover strips in North Carolina.

Below: A general view showing strip cropping on a Minnesota farm.



**Above: Cutting small grain grown in contour strips between corn in Iowa.**

**Below: Mowing oats, vetch, and Austrian peas in North Carolina.**

**Left: Chaff and dust can't keep youngsters from the harvest field.**

**Below: Shade in the harvest field is scarce but much appreciated.**

# The Editors Talk

## A New Emphasis On Plant Food

Better nutrition, one of the important planks in the Nation's Defense Program, is placing a new emphasis on plant food—the basis of all plant, livestock, and human nutrition. Although research work has uncovered much in the way of the respective nutritive values of crops grown on fertile and infertile soils, for the most part these findings have been obscured in technical, scientific publications. A notable exception was the recent statement of Dr. William A. Albrecht, Chairman, Department of Soils of the University of Missouri.

> "Mining our soils of their fertility is bringing us face to face with the simple fact that plant factories are not running as efficiently for feed production as they once did. Our farm meat and milk factories are, consequently, also operating on less efficient levels—all our knowledge about better nutrition notwithstanding. Hope lies not so much in diagnostic surveys in the animal factory but more in the simpler approach to treating the animals to more nearly normal nutrition by way of normal feeds grown on fertile soils."

In news stories during the past year, Dr. Albrecht described how farm animals can detect forage that has been produced from fertilized fields and will consume it with decided preference if offered with herbage from unfertilized fields. However, he pointed out, domestic animals cannot roam at will to find their preferred forage. If they are confined by fences to fields deficient in lime and fertilizer elements such as nitrogen, phosphorus, and potash, then they must suffer the consequences of malnutrition.

Dr. Albrecht believes that if dumb animals can show the way toward better agricultural practices, then it is time human beings, themselves, admitted the values of such a program. For instance, a program of pasture improvement through the use of fertilizers not only produces grasses richer in essential minerals, but promotes more rapid growth on depleted land. It provides a diet essential to the healthy growth of livestock, helps to conserve the soil, and adds to the long range value of the farm.

R. M. Evans, Administrator of the Agricultural Adjustment Administration, has stated that "Impoverished soil cannot produce good food. Just as surely as poor soil makes poor people, poor soil makes poor diets. We can't go on squandering our soil, wasting its substance and its richness as in the past if we expect to have a well-nourished, strong people in the future."

It is true that in the publicity which is being given the Better Nutrition Program in National Defense, there is little definite mention of a wiser use of plant food. More stress is being placed upon methods of marketing foodstuffs in order to retain essential minerals and vitamins in available supplies and the

distribution of these supplies to low-income groups. However, when about 32 per cent of the young men who up to now have come before draft boards for physical examination have been rejected by local doctors for health reasons and of the remaining 68 per cent that have gone into the army 18 per cent have been rejected by army physicians, it is apparent that lack of essential plant foods in the growing of foodstuffs must assume some of the responsibility. It has been brought out that malnutrition in this country is prevalent on a very wide scale, not only in urban, but in agricultural communities.

More closely was this responsibility defined by Secretary of Agriculture Wickard in his address on "Agricultural Policy and National Nutrition" before the National Nutrition Conference for Defense in Washington, D. C. on May 27. Secretary Wickard said, "As a matter of long-standing public policy, our State and Federal agricultural agencies are engaged in research up to the hilt, as you know. And much of this research relates to food and nutrition—better handling of our soils, conservation of our soils, better crops, better livestock, more efficient farm and home management, the battle against diseases and insects that waste our resources, better nutrition for farm animals—and better nutrition for human beings. These and more are within the scope of agricultural research, which deals with social and economic problems (yes, even psychological problems) as well as with problems in the natural sciences. Here is a fertile seedbed for such an effort as this conference is making.

"I will say frankly that in my opinion not only the United States but modern civilization as a whole will have to use this science of ours for the benefit of mankind much more fully, much less half-heartedly, than it has been used so far. We could feed and clothe and house the masses of our people far better than we do if we dared to turn science loose to tackle the job. But we have hesitated and sometimes this was because we have been afraid we might make a wrong move and upset somebody's apple cart. I think it is time to be afraid that if we don't make some vigorous moves, our civilization won't have any apples to put in the carts, and it won't matter any more whether they are upset or not."

With this challenge and the tremendously increased interest in nutrition as a vital factor, not only in physical fitness but morale, in the Defense Program, it can be predicted that more of the relationship between a well-fed soil and a well-fed people will come to light. Such an emphasis is sound, because from the beginning of time a sound people has depended upon a sound soil.



# Using Research

"The farmer's thinking has undergone a reorientation during the past two decades. No longer is the emphasis in agriculture laid on producing more, on making two blades of grass grow where only one grew before. The battle for production quantity has largely been won. Unfortunately, the victory has come at a time where mere quantity of production is no longer enough to bring success to the farmer's enterprise. . . . To achieve success he must strive toward low unit costs of production, high quality of product, constructive management of his resources, and efficient marketing. To attain these goals he needs the aid of those whose knowledge goes far beyond that of most men actively engaged in agriculture. He must make use of the results of research performed by scientists familiar with problems of engineering, sociology, economics, nutrition, chemistry, and the life sciences."—*C. B. Hutchison, Director, California Agricultural Experiment Station.*

# REVIEWS

**This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.**

## Fertilizers

¶ Professor Claude Eby, in Circular 408, of the New Jersey Agricultural Experiment Station, "Ladino Clover," advises that the crop must be liberally fed with superphosphate and potash to maintain a satisfactory stand and produce optimum yields. The same practices in seedbed preparation as for any legume-grass mixture are followed on the Station farms. The method used is to plow under 12 tons of manure per acre and apply enough limestone to the plowed soil to raise the pH to 6. Where Ladino is seeded with grasses, 400 pounds of 5-10-10 are broadcast at seeding time. For Ladino-alfalfa mixtures 800 pounds of an 0-12-12 per acre are used.

Each spring a top-dressing of between 400 and 500 pounds of an 0-12-12 is applied. In addition, a late fall dressing of about 6 tons of manure per acre is applied as a combined fertilizer and winter mulch.

The experience at the Dairy Research Farm has shown that spring seeding with a companion crop of oats that is planted as soon as the ground can be worked has proved the most satisfactory time of seeding Ladino. Successful seedings have also been made in August, without a companion crop, and in March, on stands of fall-sown winter grain and timothy. Whatever the method of seeding, the companion crop should be pastured early or made into grass silage.

*"Purpose and Working of the Bureau of Chemistry," Dept. of Agr., Sacramento, Calif., FM-21, April 18, 1941, Alvin J. Cox.*

*"Chemical Investigations of the Tobacco Plant. VIII. The Effect Upon the Composition of the Tobacco Plant of the Form in which Nitrogen is Supplied," Agr. Exp. Sta., New Haven, Conn., Bul. 442, Nov. 1940, Hubert Bradford Vickery, George W. Pucher, Alfred J. Wakeman, and Charles S. Leavenworth.*

*"The Use of Phosphate in the Agricultural Conservation Program," Agr. Ext. Serv., Urbana, Ill., Feb. 1941, C. M. Linsley and A. L. Lang.*

*"Iowa Fertilizer Law of 1941," Dept. of Agr., Des Moines, Iowa, Bul. 84-A, Mark G. Thornburg.*

*"Suggested Fertilizers for Iowa," Iowa State Coll., Ames, Iowa.*

*"The Influence on Cotton Production of Nitrogen, Phosphorus, and Potassium and Their Combination," Agr. Exp. Sta., State College, Miss., Bul. 357, Mar. 1941, J. L. Anthony and John Pitner.*

*"1941 Fertilizer Recommendations," Agr. Exp. Sta., State College, Miss., Inf. Sheet 227, Jan. 1941, Clarence Dorman.*

*"Fertilizer Rates and Analysis Tests, Holly Springs, Mississippi," Agr. Exp. Sta., State College, Miss., Inf. Sheet 234, Feb. 1941, E. B. Ferris and Russell Coleman.*

*"Soil Fertility Experiment with Cotton—Schaefer Field—Yazoo River Soil in the South East Delta," Agr. Exp. Sta., State College, Miss., Serv. Sheet 299, Feb. 1941, Roy Kuykendall.*

*"Soil Fertility Experiments with Cotton—Ladd Field—North of the Central East Delta," Agr. Exp. Sta., State College, Miss., Serv. Sheet 305, Feb. 1941, Roy Kuykendall.*

*"Soil Fertility Experiments with Cotton—Hemphill Field in the Central East Delta," Agr. Exp. Sta., State College, Miss., Serv. Sheet 306, Feb. 1941, Roy Kuykendall.*

*"Commercial Fertilizers and Winter Legumes for Cotton Production—Gary Field—Tallahatchie River Soil," Agr. Exp. Sta., State College, Miss., Serv. Sheet 307, Feb. 1941, Roy Kuykendall.*

*"Food Storage in the Peach Tree in Relation to Nitrogen Fertilization," Agr. Exp. Sta., Raleigh, N. C., Tech. Bul. 67, Mar. 1941, C. F. Williams.*

*"Use of T. V. A. Phosphates and Limestone on Pastures," Agr. Exp. Sta., Raleigh, N. C., Agron. Inf. Cir. 129, Feb. 1941, W. W. Woodhouse, Jr.*

*"Proceedings of Fertilizer Conference, Nashville, Tennessee, January 24, 1941, Agr. Ext. Serv., Knoxville, Tenn., CL-9837, Mar. 15, 1941, H. E. Hendricks.*

*"Effect of Lime on the Nitrogen Content of Cow Manure," Agr. Exp. Sta., Burlington, Vt., Bul. 456, Apr. 1940, A. R. Midgley and W. O. Mueller.*

*"Sources and Available Supplies of Commercial Fertilizers," U. S. D. A., Washington, D. C., Misc. Pub. 400, Dec. 1940, C. H. Kunsman.*

## Soils

¶ "Rapid Soil Tests for Determining the Fertilizer Requirements of Vegetable Crops in Eastern Virginia" is the title of Virginia Truck Experiment Station Bulletin 106, by E. R. Purvis and J. M. Blume. The method described by the authors for estimating fertilizer requirements of soils differs essentially from those in common use only in the case of the phosphate and potash procedures. Instead of determining the amounts of these nutrients which are removed from the soil by a specific extractant, the quantity of phosphate and potash ions absorbed by the soil from a solution of standard strength is determined.

The soil tests proposed in this bulletin have been calibrated for vegetable crops grown in Eastern Virginia. Excellent correlation between the tests and field response to applied fertilizer has been obtained with several crops. These studies are being continued and the results will be published later.

¶ Practical information of much value to Wisconsin farmers who wish to avail themselves of the opportunity to put into effect at low cost practices which will be of lasting benefit to their soil is given in the Special Circular, "Soil and Crop Practices in Wisconsin," by F. H. Turner of the Extension Division. Under the agricultural conservation program, the greater part of the expense of liming, seeding of legumes and grasses, erosion control, forestry planting and management, weed control, and the application of phosphate and potash under certain conditions is returned to the farmer in soil-building payments.

Only 20 per cent of the acid soils in the State have been limed, although Wisconsin farmers have been applying lime to soils in various forms for a quarter of a century or more. Something like 6,000,000 acres of sour, lime-deficient soils will require lime to bring back clover or to fit them for alfalfa. Fertility has been returned to the soil in the manure from home-grown and purchased feeds and by fertilization with phosphate and potash, but this falls far short of meeting the soil needs today. Erosion is taking the rich topsoil from the fields, and the subsoil is being farmed in many cases.

The contents of this comprehensive publication should materially aid those farmers who, because they could not meet the cash investment, have been unable to carry out practices which are recognized as badly needed.

*"Soil Survey Map of County of Haldimand, Province of Ontario," Ont. Agr. Coll., Guelph, Ont., Canada, Soil Survey Rpt. No. 4.*

*"Soil Survey Map of County of Welland, Province of Ontario," Ont. Agr. Coll., Guelph, Ont., Canada, Soil Survey Rpt. No. 5.*

*"Farming Point Rows," Agr. Ext. Serv., Honolulu, T. H., Agr. Ext. Cir. 111, Apr. 1941, Norman King.*

*"Conservation of Massachusetts Soils," Agr. Ext. Serv., Amherst, Mass., Leaflet 193, Mar. 1941, A. B. Beaumont and Karol Kucinski.*

*"Soil and Field-Crop Management for Southeastern New York," Cornell Univ., Agr. Exp. Sta., Ithaca, N. Y., Bul. 746, Dec. 1940, A. F. Gustafson.*

*"Tables of Characteristics of Tennessee Soils According to Soil Regions," Agr. Ext. Serv., Knoxville, Tenn., Sp. Cir. 129, Sept. 1940, L. J. Strickland.*

*"Strip Cropping to Control Erosion," Agr. Ext. Serv., Madison, Wis., Ext. Cir. 317, Mar. 1941, O. R. Zeasman.*

*"Toward Soil Security on the Northern Great Plains," U. S. D. A., Washington, D. C., Farmers' Bul. 1864, Jan. 1941, Glenn K. Rule.*

*"The Mineral Composition of Crops With Particular Reference to the Soils in Which They Were Grown," U. S. D. A., Washington, D. C., Misc. Pub. 369, Mar. 1941, Kenneth C. Beeson.*

*"Selenium Occurrence in Certain Soils in the United States, With a Discussion of Related Topics: Fifth Report," U. S. D. A., Washington, D. C., Tech. Bul. 758, Mar. 1941, K. T. Williams, H. W. Lakin, and H. G. Byers.*

*"Guarding a Heritage," U. S. D. A., Washington, D. C., Feb. 1941.*

*"Erosion and Related Land Use Conditions*

*in the Conestoga Area, Pennsylvania," U. S. D. A., Washington, D. C., Erosion Survey 15, Oct. 1940, Jay A. Bonsteel and Turner C. Bass.*

*"Erosion and Related Land Use Conditions in Winona County, Minnesota," U. S. D. A., Washington, D. C., Erosion Survey 17, Jan. 1941, Mark H. Brown and Iver J. Nygard.*

*"New Landmarks of Soil Conservation," U. S. D. A., Washington, D. C., 1941.*

## Crops

¶ According to New York State Experiment Station Circular 191, "Increasing Tomato Yields," by C. B. Sayre, successful production of tomatoes depends on attention to certain important details, such as selection of a fertile, well-drained soil rich in organic matter, liberal fertilization with a complete fertilizer high in phosphorus, early transplanting, and proper cultivation to keep down weeds.

Where manure is available, it should be applied to the tomato soil preferably in the fall supplemented with superphosphate or a complete fertilizer such as a 5-20-5 ratio. At least 600 pounds of complete fertilizer per acre should be used. Where manure is not available, more fertilizer should be applied and the ratio of nitrogen and potash increased. A 10-20-10 analysis at the rate of 600 pounds per acre or more is recommended for most soils.

Generally speaking, a high yield per acre is a most important factor affecting net returns in tomato growing. The grower who practices the improved methods of tomato production explained in this publication, and thus increases his yields per acre, will not only aid the government program of increased production, but will also increase his net returns.

Among the starter solutions that have given excellent results are 11-32-14 and 13-26-13 transplanting mixtures at 4 to 8 pounds per 50 gallons of water. If properly used, a starter solution may be expected to increase the yields about 1½ to 2 tons per acre, most of which gain will come in the early pickings. The cost of materials in the transplanting solution is only about 80 cents to $1.00 per acre. The use of nutrient solutions, if poured around the roots at the time of transplanting, will aid the plants in recovering more quickly from the usual setback caused by the transplanting operation.

Varieties and direct seeding of tomatoes are among the other topics discussed.

*"Diseases of Truck Crops," Agr. Ext. Serv., Berkeley, Calif., Cir. 119, Sept. 1940, Ralph E. Smith.*

*"Report of the Department of Agriculture, Province of Nova Scotia for the Year Ended November 30, 1940," Dept. of Agr., Halifax, Nova Scotia, Canada.*

*"Co-operative Potato Projects In Western Ontario," Dominion Exp. Farms, Guelph, Ont., Canada, Prog. Rpt. 1940.*

*"Biennial Report of the Commissioner of Agriculture for the Fiscal Period July 1, 1938, to June 30, 1940," Dept. of Agr., Hartford, Conn., Public Document No. 18.*

*"Annual Report of the Director for the Fiscal Year Ending June 30, 1940," Agr. Exp. Sta., Newark, Del., Bul. 227, Nov. 1940.*

*"Cucumber Growing in Delaware," Agr. Exp. Sta., Newark, Del., Hort. Pamph. 2, Apr. 1941, W. H. Phillips, Jr.*

*"U. S. D. A. #34 Sweet Corn Roguing Plants and Selecting Seed," Agr. Ext. Serv., Honolulu, T. H., Cir. 113, Apr. 1941, Ashley C. Browne.*

*"Sorghum Production in Hawaii," Agr. Ext. Serv., Honolulu, T. H., Cir. 114, Apr. 1941, Ashley C. Browne.*

*"Flaxseed Production in Illinois," Agr. Exp. Sta., Urbana, Illinois, Mar. 1941, G. H. Dungan and W. L. Burlison.*

*"1940 Report of the Muscatine Island Field Station," Agr. Ext. Serv., Ames, Iowa, FG 461.*

*"Profitable Dairy Feeding," Ag. Ext. Serv., College Park, Md., Bul. 89, Dec. 1940, Kenneth L. Turk.*

*"Peach Culture in Michigan," Agr. Exp. Sta., East Lansing, Mich., Cir. Bul. 177, Mar. 1941, Stanley Johnston.*

*"Forty-Seventh Annual Report, July 1, 1939, to June 30, 1940," Agr. Exp. Sta., Univ. Farm, St. Paul, Minn.*

*"Developing the Framework of Tung Trees from Dormant Buds," Agr. Exp. Sta., State College, Miss., Cir. 102, Apr. 1941, J. C. Robert.*

*"Methods of Field Curing Hay," Agr. Exp. Sta., State College, Miss., Bul. 353, Dec. 1940, T. N. Jones, O. A. Leonard, and I. E. Hamblin.*

*"Growing Cucumbers for Pickling in Mississippi," Agr. Exp. Sta., State College, Miss., Bul. 355, Apr. 1941, W. S. Anderson.*

*"Bromegrass Production in Nebraska," Agr. Exp. Sta., Lincoln, Nebr., Cir. 68, Mar. 1941, A. L. Frolik and L. C. Newell.*

*"Soybeans in New Hampshire," Agr. Exp. Sta., Durham, N. H., Cir. 57, Jan. 1941, Ford S. Prince, L. J. Higgins, Paul T. Blood, and G. P. Percival.*

*"The Apple Orchard in New Hampshire," Ext. Serv., Durham, N. H., Bul. 59, Jan. 1941, C. O. Rawlings, L. P. Latimer, W. W. Smith, and A. F. Yeager.*

*"Putting Profit in Tomato Growing," Agr. Exp. Sta., New Brunswick, N. J., Cir. 409, Apr. 1941.*

*"Fifty-First Annual Report, 1939-1940," Agr. Exp. Sta., State College, N. M., Dec. 1940.*

*"Pinto Bean Improvement," Agr. Exp. Sta., State College, N. M., Bul. 270, Mar. 1940, G. N. Stroman, John Carter, Jr., and J. C. Overpeck.*

*"Quality of Cotton Produced in New Mexico, 1936-1939," Agr. Exp. Sta., State College, N. M., Bul. 274, Feb. 1941, Frank Lowenstein and J. C. Overpeck.*

*"Fifty-Third Annual Report, 1940," Cornell Univ., Agr. Exp. Sta., Ithaca, N. Y.*

*"Lettuce Growing in North Carolina," Agr. Ext. Serv., Raleigh, N. C., Ext. Cir. 248, Feb. 1941, Robert Schmidt.*

*"The Ohio Cooperative Corn Performance Tests," Agr. Exp. Sta, Wooster, Ohio, Sp. Cir. 61, Feb. 1941, G. H. Stringfield, R. D. Lewis, and H. L. Pfaff.*

*"The Effects of Burning Pasture and Woodland Vegetation," Agr. Exp. Sta., Stillwater, Okla., Sta. Bul. B-247, Apr. 1941, Harry M. Elwell, Harley A. Daniel, and F. A. Fenton.*

*"Cotton Variety Tests Conducted at Lawton, Oklahoma, in 1940," Agr. Exp. Sta., Stillwater, Okla., Sta. Cir. C-93, Apr. 1941, Henry E. Dunlavy, I. M. Parrott, and Ferd W. Self.*

*"Johnson Grass," Agr. Ext. Serv., Corvallis, Ore., Ext. Bul. 547, Oct. 1940, Lawrence Jenkins and E. R. Jackman.*

*"Trials of Annual Flowers," Agr. Exp. Sta., State College, Pa., Bul. 402, Feb. 1941, E. I. Wilde and J. R. Culbert.*

*"Questions and Answers Concerning the Use of Crimson Clover in Tennessee in 1941," Agr. Ext. Serv., Knoxville, Tenn., Sp. Cir. 146, Apr. 10, 1941, H. E. Hendricks.*

*"The Use of Sudan Grass Pastures and Other Feeds for Beef Production," Agr. Exp. Sta., College Station, Tex., Bul. 599, Mar. 1941, J. H. Jones, J. M. Jones, R. A. Hall, and E. M. Neal.*

*"What's New in Farm Science, Part Two, Annual Report," Agr. Exp. Sta., Madison, Wis., Bul. 451, Apr. 1941.*

*"The Making and Feeding of Silage," U. S. D. A., Washington, D. C., Farmers' Bul. 578, Rev. Feb. 1941, T. E. Woodward, W. H. Black, D. A. Spencer, and J. O. Williams.*

*"Strawberry Culture, Eastern United States," U. S. D. A., Washington, D. C., Farmers' Bul. 1028, Rev. Feb. 1941, George M. Darrow.*

*"The Home Fruit Garden on the Northern Great Plains," U. S. D. A., Washington, D. C., Farmers' Bul. 1522, Rev. Nov. 1940, W. P. Baird.*

*"Culture, Diseases, and Pests of the Box Tree," U. S. D. A., Washington, D. C., Farmers' Bul. 1855, Nov. 1940, Freeman Weiss and L. G. Baumhofer.*

*"Sugar-Beet Culture Under Irrigation in the Northern Great Plains," U. S. D. A., Washington, D. C., Farmers' Bul. 1867, Apr. 1941, S. B. Nuckols.*

*"The Relation of Firmness to Ripeness of Eastern-Grown Apples," U. S. D. A., Washington, D. C., Cir. 579, Jan. 1941, M. H. Haller, J. M. Lutz, and E. D. Mallison.*

*"Intensive Projects Under the Cooperative Farm Forestry Act," U. S. D. A., Washington, D. C., Leaflet 208.*

*"Methods of Distinguishing Between the Shipmast and Common Forms of Black Locust on Long Island, N. Y.," U. S. D. A., Washington, D. C., Tech. Bul. 742, Jan. 1941, Henry Hopp.*

*"Seasonal Changes in Florida Oranges," U. S. D. A., Washington, D. C., Tech. Bul. 753, Dec. 1940, Paul L. Harding, J. R. Winston, and D. F. Fisher.*

*"Restoring Conifers to Aspen Lands in the Lake States," U. S. D. A., Washington, D. C., Tech. Bul. 763, Mar. 1941, Hardy L. Shirley.*

## Economics

¶ Because of a prolonged period of low cotton prices, farmers in the South are particularly interested in and are seeking new sources of cash income. An example is the sweetpotato starch plant at Laurel, Mississippi, sometimes referred to as the "Chemurgic City." The effects of this new enterprise on farm income and organization in the surrounding countryside are studied and reported in Mississippi Experiment Station Bulletin No. 352, "Factors for Success on Starch Sweetpotato and General Farms in Jones County, Mississippi, 1939," by Marvin Guin, D. W. Parvin, and A. J. Huff.

Climatic and soil conditions seem to favor the sweetpotato crop in Mississippi. It is the most important vegetable crop produced in the Southern States, and Mississippi is one of the leading producing areas. In 1934 the Mississippi Relief Administration obtained a grant of $172,000 from the Federal Emergency Relief Administration for the purpose of establishing at Laurel a project for the purpose of manufacturing starch and by-product pulp from sweetpotatoes. The process to be employed was that developed by the U. S. Department of Agriculture, and

the plant was operated by the Department of Agriculture through the Resettlement Administration and the Farm Security Administration.

In 1938 title was transferred to the Sweetpotato Growers, Inc. The plant is now operated by this cooperative under the trade name of The Laurel Starch Plant, and funds are obtained through loans from the Farm Security Administration. It is an interesting project in that it is more or less an experiment in what can be accomplished in the way of rendering the country self-sufficient in an imported material and at the same time providing a new source of income for agriculture. The extent to which the project could be enlarged if it is successful is demonstrated by the fact that it would require about 177 similar plants to make as much root starch as the United States annually imports.

About 25,000 bushels of starch sweetpotatoes were received by the plant in 1934 from fields averaging about 100 bushels per acre. Since then the yield per acre and total production have increased steadily until in 1938 the starch plant received 165,000 bushels of potatoes with an estimated yield of 200 bushels per acre. In 1939 265,000 bushels were delivered for manufacture of 2,700,000 pounds of starch.

In order to study the effect of this enterprise on the surrounding farms, 100 farms in Jones County were surveyed in 1939, a year in which farming was below average because of low yields of crops in general. The total investment per farm ranged from $2,000 to $6,000 and averaged $3,930. The farms growing starch potatoes had a higher per cent of their total capital invested in operating capital than did the group of comparable farms not growing starch potatoes. The average farm in the region surveyed returned about 4.3% interest on the invested capital. The returns ranged from 7.4% on the farms growing starch potatoes to 1.1% on the non-starch potato farms.

Cotton and starch potatoes were the two most important crops grown, representing 73% of the total crop receipts of which 54% was obtained from cotton and 19% from starch potatoes. The livestock enterprise was comparatively insignificant, but the farms growing starch potatoes had more than twice as much income from livestock and livestock products as the farmers not growing starch potatoes.

Total farm receipts for the 100 farms averaged $1,081, ranging from $89 on a one-horse cotton farm with no starch potatoes to $8,495 on a highly diversified farm with $1,200 cash receipts from starch potatoes. Labor income on all farms averaged $157 and ranged from $295 on the starch potato farms to $23 on farms which did not grow starch potatoes. The labor income varied from a loss of $550 on a farm with only cotton as the cash crop to $1,983 on a large diversified farm with starch potatoes. The majority of the farmers fell within the range of $249 loss to $249 income.

The study indicates that farmers who spent less time on cotton and livestock and more time on starch potatoes and other crops used labor and other factors of production more efficiently and obtained more profits per farm. Starch potatoes required a few more man hours per acre than did cotton. The average of receipts per acre from cotton and cottonseed was $30.37, and the average of expenses was $24.57, leaving a net return of $5.80 per acre. The average of receipts per acre of starch potatoes was $49.80 with a net return of $7.92 per acre. In other words, the net return from starch potatoes exceeded that of cotton by $2.12 per acre.

All in all, the farms growing starch potatoes had a much higher receipt per farm, higher farm income, labor income, labor earnings, and per cent return on capital than did the group of comparable farms that did not grow starch potatoes. Starch potato farms were more diversified with higher receipts from livestock and crops other than cotton. However, it should not be construed from the above that starch potatoes were entirely responsible for the more favorable showing of the farms

where they were grown, because it was noted that the more progressive farmers grew starch potatoes and as a group they would naturally be expected to have a higher income than the less progressive farmers even though they were not growing potatoes.

*"Farmer Cooperation in Northern Alabama," Agr. Exp. Sta., Auburn, Ala., Bul. 249, Mar. 1941, L. C. Salter and E. L. Morgan.*

*"Bureau of Chemistry, Annual Report for the Calendar Year 1940," Dept. of Agr., Sacramento, Calif., Vol. XXIX, No. 4, Oct., Nov., and Dec., 1940, Alvin J. Cox.*

*"Connecticut Vegetable Industry and Its Outlook for 1941," Dept. of Agr., Hartford, Conn., Bul. 71, Apr. 1941.*

*"Summary of Shipments of Fruits and Vegetables from Hawaii to the Mainland 1940," Agr. Ext. Serv., Honolulu, T. H., Agr. Ext. Cir. 110, Mar. 1941, Kenneth I. Hanson and Kenichi Murata.*

*"Illinois Crop and Livestock Statistics by Counties," Dept. of Agr., Springfield, Ill., Jan. 2, 1941.*

*"Tonnage of Fertilizer Reported by Manufacturers as Shipped to Kansas During the Year 1940, by Counties," State Board of Agr., Control Div., Topeka, Kans., May 1, 1941.*

*"Production and Marketing of Maryland Sweet Potatoes," Agr. Exp. Sta., College Park, Md., Bul. 436, Aug. 1940, C. H. Seufferle, R. F. Burdette, A. B. Hamilton, and S. H. DeVault.*

*"Minnesota State Farm Census for 1940," Dept. of Agr., St. Paul, Minn., Bul. 37, Dec. 31, 1940.*

*"Seasonal Variation and Economy of Basic Feeds, 1924-1940," Agr. Exp. Sta., Columbia, Mo., Bul. 422, Mar. 1941, Herman M. Haag and Norman St. John.*

*"Analyses of Commercial Fertilizers, Manures, and Agricultural Lime, 1940," Agr. Exp. Sta., New Brunswick, N. J., Insp. Series 2, Feb. 1941, Charles S. Cathcart.*

*"Wheat Production in Oklahoma, 1894-1938," Agr. Exp. Sta., Stillwater, Okla., Exp. Sta. Cir. 92, Apr. 1941, K. D. Blood and Marjorie Lee Hill.*

*"Inspection of Fertilizers, Made for the State Department of Agriculture and Conservation," Agr. Exp. Sta., Kingston, R. I., An. Fert. Cir., Jan. 1941, W. L. Adams and T. Wright, Jr.*

*"An Economic Study of Agriculture in the Little Beaverdam Creek Area, Anderson County, South Carolina," Agr. Exp. Sta., Clemson, S. C., Bul. 332, Mar. 1941, M. J. Peterson.*

*"Planning Minimum Sized Ranches and Farms for the Hyde County Area in South Dakota," Agr. Exp. Sta., Brookings, S. Dak., Bul. 346, Dec. 1940, Aaron G. Nelson.*

*"Land Use in Relation to Sedimentation in Reservoirs, Trinity River Basin, Texas," Agr. Exp. Sta., College Station, Tex., Bul. 597, Jan. 1941, Alexis N. Garin and L. P. Gabbard.*

*"Commercial Fertilizers—1941," Dept. of Agr., Madison, Wis., Bul. 218, Mar. 1941, W. B. Griem.*

*"Grain Prices and the Futures Market, a 15-Year Survey, 1923-1938," U. S. D. A., Washington, D. C., Tech. Bul. 747, Jan. 1941, G. Wright Hoffman.*

*"Trends in Dairying by Major Type-of-Farming Regions," U. S. D. A., Washington, D. C., Tech. Bul. 751, Jan. 1941, W. F. Finner and Ronald L. Mighell.*

*"Farm Tenancy," U. S. D. A., Washington, D. C., Co. Plan, Series 9.*

*"Problems of Farm Tenancy," U. S. D. A., Washington, D. C., Co. Plan. Series 10.*

*"Determination of Normal Yield of Commercially Recoverable Sugar Per Acre and Eligibility for Payment With Respect to Abandonment and Crop Deficiency for Farms in the Mainland Cane Sugar Area," U. S. D. A., Washington, D. C., S. D. 92, Oct. 22, 1940.*

*"Determination of Farming Practices to be Carried Out in Connection With the Production of Sugarcane During the Crop Year 1940-41 for Puerto Rico," U. S. D. A., Washington, D. C., S. D. 100, Dec. 4, 1940.*

*"The Citrus Industry and the California Fruit Growers Exchange System," U. S. D. A., Washington, D. C., Cir. C-121, June 1940, Nephtune Fogelberg and A. W. McKay.*

*"State Legislation for Better Land Use," U. S. D. A., Washington, D. C., Sp. Rpt., Apr. 1941.*

*"Income Parity for Agriculture. Part I.—Farm Income. Section 14.—Income from Truck Crops and Farm Gardens," U. S. D. A., Washington, D. C., Feb. 1941.*

*"Farm Production, Farm Disposition, and Value of Principal Crops, 1938-1940," U. S. D. A., Washington, D. C., Apr. 1941.*

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Bachelor (dreamily): "Sometimes I yearn for the peace and comfort of married life."

Married Friend (wistfully): "I always do."

"You drunken beast! If I were in your condition I'd shoot myself!"

"Lady, if you wazh in my c'ndishun, you'd mish yershelf!"

# Getting the Most from Fertilizer

PROPER application is a big factor in getting full return from the fertilizer dollar. Applying fertilizer in the right place is fully as important as applying the right analysis or the right amount. This fact was largely overlooked by soils investigators until about 1925. Even today it is not fully appreciated by farmers. Many continue to use antiquated machines and methods whose low efficiency has been shown.

Fertilizer is ordinarily applied in either of two ways: (1) over the entire soil surface by the method commonly referred to as "broadcasting," or (2) in a localized area close to the seed or plant, usually termed hill or row placement. Broadcast applications commonly involve a separate operation in addition to seeding. The fertilizer may be spread on the surface, with or without incorporation, or it may be placed below the soil surface in closely spaced rows using a fertilizer drill. Hill or row applications are usually made through a fertilizer attachment on the planter. Hence, they do not involve a separate operation and save labor.

### Cooperative Study

Knowledge of the principles and practice of fertilizer application has expanded rapidly in recent years. Scientific studies in the laboratory, controlled hand and machine placement studies in the field, and performance tests with commercial fertilizer distribution, all have played a part. The Experiment Stations in 20 States and the U. S. Department of Agriculture have cooperated in these studies.

Coming from this work, certain principles stand out as of rather general application, almost irrespective of the soil or crop. One of these is that maximum efficiency from fertilizer treatments is obtained by placing the fertilizer as close to the seed or plant as is possible without injuring germination or seedling growth. With hill or row crops, this means placing the fertilizer in the hill or row in preference to broadcasting.

Too much mixing of the fertilizer with the soil reduces its efficiency because of the power that soils have of rendering phosphates and potash insoluble. When fertilizer injury occurs, it results from too much soluble salt entering the soil solution close to the seed or young plant. Fertilizer salts used to supply nitrogen and potash are apt to be more injurious than phosphates.

### No Single Pattern

Fertilizer salts move up and down with the soil water—down following a rain and up when moisture is evaporating from the surface. Almost no horizontal movement of such salts occurs. Crops differ in their sensitivity. In general, the legumes such as soybeans, peas, clover, and alfalfa are more easily injured than corn, sugar beets, potatoes, or small grains.

Contrary to ideas of a few years ago, hill or row application does not tend to limit the spread or penetration of the root system. However, in occasional years of severe drouth, hill application may exaggerate the bad effects of dry weather, sometimes causing the crop to "fire." It is probable, though, that such injury is the direct result of the more rapid early growth resulting from this method of application, and consequently the larger need for water.

No single fertilizer pattern has been found superior with all crops and under all conditions. Almost without exception, however, placing the fertilizer at the sides of the seed has been close to the top in efficiency. On the average, no other placement appears even a close second.

Fertilizer is most apt to injure when it is placed directly in contact with the seed. Placement in bands directly over the seed is usually not advisable, the fertilizer tending to wash down around the seed and injure it. Bands directly

below the seed are but little better, especially if placed at shallow depth. This is because the fertilizer tends to rise with the capillary water and cause trouble. Mixing the fertilizer in the row with the seed or under the seed is sometimes satisfactory, but not if the soil happens to remain fairly dry after planting.—*G. E. Ferris, Ohio Agricultural Extension Service.*

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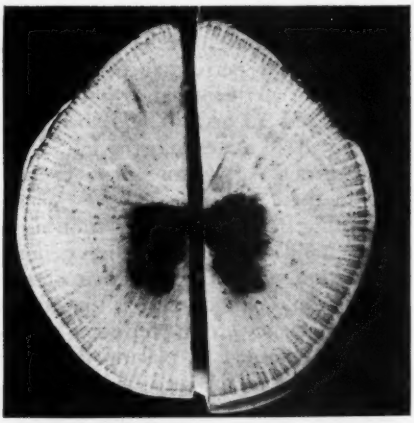
# Boron—a Minor Plant Nutrient of Major Importance

(*From page* 19)

Some very profitable responses to boron have been realized from horticultural and field crops. While experiments showed an indicated loss from use of boron on some small fruit crops the second year after treatment, there was some increase in cane size and fruit yield. Grass and small grains have relatively low boron contents, yet response to boron has been observed with these crops. Schropp and Arenz (1940) found boron essential for formation of barley kernels. The grasses in mixtures may receive indirect benefit.

Rate and duration of treatment have been varied with several soils and crops. Slight temporary toxicity without economic loss has been observed with corn where a 30-pound application was made inadvertently the second year. Lawn grass was slightly off color for 10 days following an application of 40 pounds of boric acid an acre. Yields of alfalfa have increased with increasing rates of borax applications up to 60 pounds an acre. It appears that 30 pounds of borax an acre can be safely used for most purposes. This rate has given commercial but not complete control of beet canker. Heavier applications than this seem advisable unless placement at the side of the row will give more complete control. A 30-pound treatment appears to be effective for 2 or 3 years. Most prompt results in experimental tests have followed where application was by sprinkling in aqueous solution. The borax may be broadcast with a cyclone type of grass seed hand sower. It has been used successfully by mixing with gypsum or superphosphate. Early application is important.

Some data as to boron in soils and plants appear in an earlier report (Powers, 1939). We are now using the quinalizarin method of Berger and Truog (1940) for nearly available boron. Old soils, leachy soils, peaty soils, or those derived from igneous rocks seem most apt to be deficient in boron. Soil reaction or liming, soil moisture content, colloidality and organic matter contents, and perhaps also the temperature may affect boron availability. So, boric acid may be best used for experimental tests on basic soils. Two pounds of boric acid will supply approximately as much boron as three pounds of borax.



**Boron deficiency caused this dark heart of turnips on Chehalis silt loam.**

**Boron on alfalfa grown on Amity silty clay loam increased seasoned hay yield 1½ tons an acre.**

The boron content of plant material tested has ranged from 7 to 50 parts per million and has been markedly lower in plants needing boron than in normal plants or those grown on boron-treated soils.

There are now some 50,000 acres of alfalfa in the Willamette Valley that will yield ½ ton to 1 ton more an acre from the borax treatment which costs about $1 an acre for a 30-pound application. Loss due to beet canker has been 8 to 10 per cent, and loss in celery up to 50 per cent.

Twenty tons of borax were used for fertilizer in Oregon in 1939 and more than 100 tons in 1940. A minor amount of boron is a major factor in plant nutrition over wide areas of the Pacific Northwest, and nutrition is a large factor in national security.

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## Basing a Program on What the Soil Tells

(*From page* 13)

and 91 per cent showing "Low" to "Very Low" on potash, it meant one of two things—disregard the signs or step up the use of potash. The latter was chosen, and today a program in which potash is equal in importance to phosphorus, and on the very dark soils is above that figure, is being pushed.

The issue of more potash has taken root with the farmers, over the past six years, because they found the straw just a little stiffer, the test weight a little heavier, the maturity a little more normal, the yield a little higher, and a better, more even, longer lasting legume crop. Like "Topsy" the program for more potash "just grew."

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# Give Due Consideration To Dominant Soil Types

FOR many years it has been recognized that every agricultural soil type has not only its strong and weak points, with reference to available plant-food resources, but that each possesses certain characteristics and aspects which make it peculiarly better suited for the growth of certain crops and for the practice of certain types of farming. This special crop adaptation to soil types has been strikingly brought out time and again with many crops in our work in North Carolina during the past 10 to 15 years. As a matter of fact almost every crop, *for optimum growth,* seems to have soil requirements which are best met by a particular soil type or types closely related to it.

Two illustrations of special crop adaptation to soil types are seen in tobacco and red and closely related clovers. It has been known for a long time that if tobacco is to attain high quality, it has to be grown on certain kinds or types of soil and has to be fertilized in such a way and at such a time as to best supplement the available plant-food resources of the particular soil. It is well known that generally best results are secured when it is grown on certain types of the Marlboro, Norfolk, Durham, Appling, Granville, and Cecil series of soil. If set on other types of soil, the quality of the tobacco is quite likely to suffer, and bring lower prices.

It has been observed for some years in the Piedmont section of North Carolina that red and allied clovers did much better and were being grown much more generally in some communities than in others in the same counties. In an effort to determine the cause or causes for this somewhat irregular distribution, it was found that successful growth, in many, if not in most cases, was closely associated with type or types of soil which the communities had, and to which these legumes are specially adapted. It became evident that Davidson clay loam is one of these, for wherever one finds this type of soil well developed and occurring to any great extent, red and other clovers will usually be occupying a considerably larger proportion of the total acreage of the cultivated land than will be the case on other types of soil occurring in the same counties. With proper care in seeding, alfalfa frequently, if not most generally, attains its maximum success on this and closely related types of soil.

These observations are significant in pointing the way for a safe and sound plan of promoting the growth of special crops in the South and for establishing untried types or systems of farming.

Especially will this be found true for those crops which appear to be rather exacting in their soil requirements, like tobacco, red clover, and alfalfa. The crops grown or attempted to be grown and the types of farming to be practiced in any community should fit into the character of the dominant soils, if best returns, other things being equal, are to be secured.—*Professor C. B. Williams, North Carolina State College of Agriculture.*

# Plant's Contents Show Its Nutrient Needs

(*From page* 11)

calcium, 36 pounds of phosphorus, and 88 pounds of potassium must be provided by the soil for the production of maximum yields and good quality hay.

In terms of plant-food material, an application of 500 pounds of limestone, 400 pounds of 20 per cent superphosphate, and 200 pounds of muriate of potash should be sufficient for maximum yields of lespedeza on soils of lateritic origin.

Crimson clover has been grown in the South for years, but many farmers have abandoned the crop because of the difficulty in securing stands. A field experiment was designed in 1939 to study its fertility and pH requirements. The observations to date show that this legume is best adapted to sandy loam soils and is very responsive to phosphorus. The maximum yield of 4,192 pounds of oven-dry hay was produced on the plat which received 600 pounds of 20 per cent superphosphate, 100 pounds of muriate of potash, and sufficient limestone to obtain a pH of 6.28. The 100-pound potash plat yielded 2,450 pounds of oven-dry hay and the check plat yielded 2,150 pounds per acre. Further observation on high-lime plats (pH values above 7.0) showed symptoms of potash deficiency, indicating that such high pH values are not desirable; whereas from 300 to 600 pounds of superphosphate and 100 pounds of muriate of potash are essential for obtaining a successful production of crimson clover.

Data accumulated from a pot experiment with Austrian winter peas show that peas are a fairly acid-tolerant crop, but are best adapted to only slightly

TABLE 1—THE EFFECT OF FERTILITY ON YIELD AND NUTRIENT CONTEST OF LESPEDEZA AT OPTIMUM pH RANGE OF 6.0 TO 6.5

| Fertilizer | Yield Grams/Pot | Plant Composition | | |
|---|---|---|---|---|
| | | Pounds per Acre | | |
| | | Calcium | Phosphorus | Potassium |
| 0 | 40.9 | 122 | 21 | 62 |
| 600# 0–10–0 | 46.0 | 152 | 30 | 74 |
| 1200# 0–10–0 | 51.6 | 175 | 36 | 88 |
| 600# 0–10–5 | 46.1 | 146 | 26 | 82 |
| 1200# 0–10–5 | 45.7 | 126 | 24 | 120 |

acid soils. Maximum yields were obtained at a pH range of 6.0-6.2. The results, as far as fertility requirements are concerned, are similar to those secured for lespedeza. They further emphasize the necessity of providing an ample supply of calcium and phosphorus for crop production and maximum mobilization of nutrients in the crop. The nutrient content at optimum growth indicates that plant-food materials corresponding to 320 pounds of limestone, 350 pounds of superphosphate, and 300 pounds of muriate of potash will provide the required nutrients for winter peas. Thus on lateritic soils, the successful production of legumes can be assured by providing a relatively high fertility level through using lime, superphosphate, and potash.

# A Balanced Diet for Nursery Stock

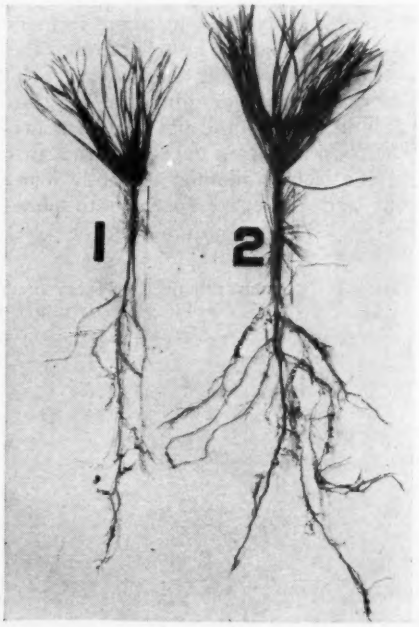
(*From page* 16)

raised on fertilized nursery soils with a well-balanced ratio of nutrients. These findings were fully substantiated by the studies of the Lake States Forest Experiment Station.

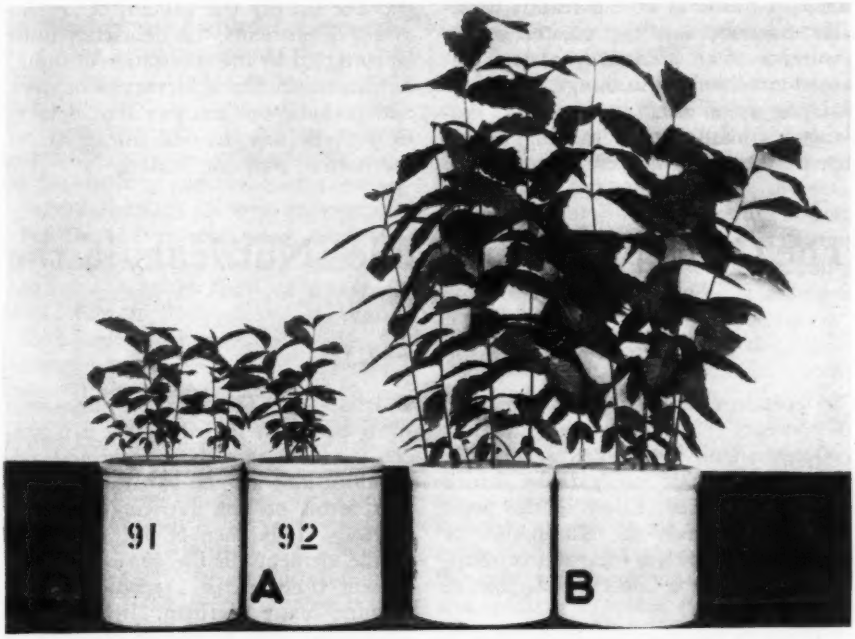
The adjustment of fertility in nursery soils is accomplished chiefly by the application of peat, duff or leafmold, other organic remains, and soluble fertilizers. The commonly applied mineral fertilizers include ammonium sulfate, nitrate of soda, superphosphate, ammonium phosphate, potassium nitrate, and sulfate or muriate of potash. Other commercial fertilizers are used only in exceptional cases. The use of nitrate fertilizers is largely confined to liquid treatments or blocks with hardwood stock. As a rule, the content of nitrate nitrogen does not exceed half of the total content of soluble nitrogen applied. In rare instances the colloidal content of soil is increased by additions of clay, and the soil reaction is adjusted by acidifying agents, such as sulfur or aluminum sulfate. Ordinarily the pH value, colloidal content, and associated fertility factors are brought to the desirable level by an addition of organic remains having suitable reaction, exchange capacity, and content of bases.

The determination of the necessary amounts of fertilizing materials to be applied is a matter of simple arithmetic based on the chemical analyses of the soil and fertilizers.

Not all of the nursery soils may be raised to a satisfactory fertility level by a single application of salts and absorbing colloids. The introduction of large quantities of raw organic remains and mineral fertilizers may bring about a deficiency of available nitrogen or a toxicity of soil solution due to a high




**Effect of a complete well-balanced fertilizer (2) upon the development of 2-year-old Scotch pine seedlings grown in Trout Lake State Forest Nursery, Wisconsin. Note the slight difference in the size of the crowns as compared with the large difference in the stem diameters and size of root systems.**




**Growth of a 4-months-old American elm on a depleted Miami loam soil from the University of Wisconsin Arboretum (A), and the same soil with the fertility adjusted (B).**

concentration of salts. For this reason, in soils of a low fertility, it may be desirable to extend the soil-improvement program over a period of several years. Experience has shown that most soils, including those of sandy texture, can be brought into a fully productive state in the course of three 2-year rotations.

It is important in the management of nursery soils to keep in mind the relationship that exists between the total soil fertility, the fraction of nutrients in the soil solution, and the amount of nutrients actually required by seedlings during their 1- or 2-year period of growth.

The amount of a nutrient which is necessary for actual annual metabolism of forest seedlings constitutes, as a rule, but a small fraction of the total available supply of this nutrient present in a productive nursery soil. For example, the amount of calcium annually taken up by the growth of even calciphilous hardwood seedlings is less than 1 milliequivalent per 100 gm., or 400 pounds per acre. Nevertheless, a productive hardwood nursery soil must contain at least 5 milliequivalents per 100 gm. of replaceable calcium, or 2,000 pounds per acre. The presence of this high amount is vital because calcium fulfills numerous functions in soil besides that of a plant nutrient. It promotes aggregation, regulates reaction, counteracts the toxicity of other ions, and stimulates the activity of micro-organisms.

In nursery soils, exposed to rainfall and artificial irrigation, the nutrients in solution are subject to frequent changes. During a period of abundant rainfall, the readily soluble salts are leached away and the soil is saturated with nearly pure water. After the rains have stopped, additional nutrients are gradually released into the soil solution, by hydrolysis and the activity of micro-organisms, from the more soluble minerals, exchange material, and organic compounds, i.e., from the storehouses of the plant nutrients. The higher the reserve supply of nutrients, the more

stable is the level of the readily available fraction, and the greater is the assurance of an uninterrupted and balanced nutrition of seedlings.

If, in spite of all precautions, prolonged rainfall, severe leaching, or intensive feeding of densely planted stock decrease greatly the content of certain available nutrients, the deficiency must be corrected by the application of liquid fertilizers. Careful observations of stock and periodic soil analyses should serve to prevent any serious disruption of the normal nutrient balance.

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# The Concept of "Available" Nutrients in the Soil

(*From page* 22)

"independent operational significance of concepts" (5). This means that our concepts should be defined in terms of the operations or methods by which they are measured. Likewise, this point of view demands the elimination of any concept which is incapable of measurement. Such a concept was that of "absolute time."

What factors must be considered in deciding such questions as: Can the various components of a soil serve as nutrients for plant growth, and how much of each is present in any given soil? It would seem well to recognize from the beginning that if a nutrient is "available," it of necessity must be absorbed by the crop, otherwise some reason must be given to explain its non-absorption. Experiments have shown that all the nutrients can exist in the soil in *chemical form or forms* which the plant can absorb. The exchangeable bases constitute the form of those nutrient cations most closely related to plant growth and response. Water-soluble bases are also known to be a nutrient form of these ions.

The knowledge about phosphates is much more meager at the present time, but it is the author's belief that the way to attack this problem is to study the forms of phosphates in various soils and the relationships between them with emphasis on their chemical structures. Once a form or a number of forms has been definitely established, the next step will be to determine which ones are most closely related to plant growth and response. The nitrogen question is fairly definitely settled in that it is generally agreed that the nitrate and ammonium ions are the two most important forms of this nutrient. We may correctly speak then of nutrient forms of the elements in the soil and at the present time are in a position to determine many of them. It should be mentioned that a greater quantity of most of these forms must be present in the soil than the crop can take up in any one growing season. The reason for this lies in the fact that the plant roots contact but a small percentage of the total colloidal surface of the soil where these ions are held.

### Why Change Terminology?

It is the writer's view that the term, "the available nutrient," is misleading, and further that such terms as "the available potassium" and "the readily available phosphorus" should not be used to express the results of chemical soil tests. Since the above terms are now commonly used by most soil chemists to express the results of such tests, it might well be asked, "Why change the terminology and what would be accomplished by the change?"

Most agronomists understand the term "available" to mean "usable." In the general sense this term assumes that the substance *can* be used. This assumption includes the following factors: (1) That the element is in an absorbable form; the chemical factor. (2) That a plant can get to it; the posi-

tional factor. (3) That the nutrient can be absorbed at a particular stage in the development of the plant; the physiological factor. More factors will probably be added as knowledge of plant nutrition increases. It is thus evident that calling a nutrient "available" solely on the basis of its chemical form involves a number of very questionable assumptions. It seems less confusing to the author to call the replaceable potassium a nutrient form of potassium rather than the "available" potassium.

Although some may claim that the present usage of "available" is synonymous with the writer's usage of "nutrient form," the fact that the phosphate test of Bray has been so widely misinterpreted and incorrectly used in other states constitutes evidence that the term "available" is misleading other workers in their interpretations. Other evidence to support this view is furnished by those quick tests for "available potassium" which do not attempt to measure a definite proportion of the replaceable potassium.

If a chemist finds the replaceable potassium in a soil to be 75 pounds and reports that the soil contains 75 pounds of "available potassium," no one would be justified in predicting that a corn crop which absorbed only 25 pounds of potassium would show a yield increase for further additions of potassium to that soil. Yet this response is a common ocurrence on such soils in Illinois, and to maintain the terminology one is forced to conclude that there was a difference in the availability of the "available potassium." A similar situation results when two different crops, as wheat and alfalfa, are grown on soils containing the same "amount" of "available potassium." The alfalfa absorbs more than the wheat, and again to maintain the terminology one is forced to conclude that the availability of the "available" potassium differs for the two crops.

The present viewpoint then not only accepts a general concept of availability but also includes special types, such as chemical availability, positional availability, etc. If actually followed to a conclusion, this type of reasoning would enable one to say, "All the material in the soil is available to plants, but most of it is not absorbed by a crop because of its extremely low chemical availability." This "explanation" is no more than a play on words. Since there is no evident flaw in the reasoning which leads to such a statement, it is necessary to examine the underlying assumptions of the concept itself. The most outstanding fallacy in the above reasoning is the use of the term, "the available potassium," synonymously with "the replaceable potassium." As mentioned above, the chemical form of an element is but one of the factors determining its availability. It is just this point which is disregarded in the synonymous use of the terms. Further analysis shows that there is nothing in the soil which corresponds to the "available potassium," and since a definite term should be a symbol for something definite in the soil, this term is revealed as meaningless.

If plant nutrients are classified on the basis of their chemical forms in the soil and those which can be shown to be absorbed by plants under test conditions are called nutrient forms, we shall correctly emphasize their structural status in the soil and their functional relationships to absorption by plants.

## What Would Be Accomplished?

With regard to quick tests or other chemical methods of determining soil nutrients, the point of view of the author is in essential agreement except in the manner of terminology, with that of Bray (3, 4). As Bray states in another paper (2), "It is not practical to try to measure the relative 'availability' of the replaceable potassium by a chemical test, and our best bet is to measure the total replaceable potassium present and let the crop establish the availability in terms of its own requirement." As mentioned before, it seems misleading to the author to call the replaceable potassium the "available potassium" when some factors which cannot be measured

by the test may reduce the availability to zero. It is, therefore, suggested that the results of all chemical soil tests be reported in terms of what the test actually measures. This would accomplish three things: (1) It would emphasize the importance of measuring all of the nutrient form or forms of an element or a known proportional part of each present in the soil. (2) It would emphasize the necessity for a calibration between the amount of a nutrient extracted and crop response in the field to the fertilizer in question. The importance of this calibration cannot be overemphasized and has too often been overlooked in the past. (3) It would present the results of the tests in unambiguous terms.

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# The Making of Better Pastures

(*From page* 8)

In the case of selection, only those sods that have sufficient good pasture grass varieties should be fertilized. They should be sods that are fairly deep, have considerable natural moisture, and will not dry out. In many instances pastures even though rough, stony, and perhaps on sidehill land have these qualifications and will respond well. In other words, it is not possible to make grass grow where there is nothing to develop it from.

Caledonia County sods are well supplied with wild white clover, much of the seed lying dormant in the soil only waiting for plant food to give it vitality to push up to the surface and produce a good feed. This has been very noticeable in tests around the county, or where wood ashes have been scattered,

and particularly around droppings left by the cows. Experience shows that it is not practical to scatter pasture grass seed hit-and-miss over poor sods unless there is something to cover it and particularly if no plant food is applied. Pasture tests to date show that on a good sod minerals such as potash and phosphorus are of first concern. An 0-20-20 mixture has been giving good results on permanent sods, and where considerable grass exists a 1-2-2 ratio such as an 8-16-16 does exceptionally well. In the case of the latter combination, good results can be secured where hay sods have been recently turned over to rotated pasture.

### Management Important

Management of a pasture is all important. Confining a herd on a small area assures even grazing, the consumption of the grass when it is at its best, and the development of a good sod. When the poor and mediocre sods are eliminated, the droppings are made much more effective and thus concentrate the extra plant food where needed. Where hay sods are used in the pasture program, electric fences can be employed to good advantage.

One of the best examples of pasture improvement in the County is on the farm of J. R. Moore and Son of East Barnet. Starting in 1938 on a very rough sidehill permanent pasture, Mr. Moore top-dressed with approximately 300 pounds per acre of an 8-16-16. The response was exceptional, and the same treatment was given again in 1939. In each of these years the grass responded, and the white clover came in and did not choke out. The herd of 20 cows was rotated approximately every 2 weeks on each of the 2 areas into which the pasture was divided. In 1940 most of the area was treated with 0-20-20 and the sod was maintained in good shape. For his own information last year Mr. Moore kept actual grazing data, which showed that the herd was turned out on one plot on May 16, the two plots were alternated at intervals of some two weeks each, and the first green feed to supplement the pasture was not necessary until August 6. Nearly three months of good pasturage was provided.

This area makes up the entire pasture on the farm, and the Moore herd is one of the best Jersey herds in the County, leading the first Caledonia Dairy Herd Improvement Association with an average of 432 pounds of butterfat for the year ending September 1, 1940. The herd averages well over a five per cent butterfat test. Mr. Moore's plans are to use the complete 8-16-16 mixture in alternate years with an 0-20-20 and manage the grazing so as to maintain the sod in a healthy condition, with a good mixture of grass and clover. The soil is of the Worthington fine sandy loam type, having originally had considerable lime in its make-up, and is typical of many soils in the County. The farm also grows alfalfa well.

### Other Phases of Program

Other phases of work requiring study include abandoned farms, farm wood lot improvement, soil erosion, farm and home accounts, and side-line enterprises. Concerning abandoned farms, the committee felt that the lack of good roads, good schools, and rural electrification all contributed to the abandonment of much land that could grow good crops, produce good pasture, and support good herds. It will be readily seen that all of these factors are necessary for the maintenance of good family living.

Coupled with the job of maintaining permanent pastures and making them better is the problem of soil erosion. In many sections of the County pastures that provided a good carrying capacity for dairy herds a few years ago are showing sheet erosion and even gullies which will make it necessary to take such pasture sods out of the farm rotation and either abandon the area or plant it to trees to hold the soil. Several years ago it was felt that soil erosion was a far cry from Vermont, but the truth of the matter is that it is here and here to stay. Already three soil

conservation districts have been formed with erosion as a major problem for control, and more localities are anxious to form districts as soon as supervision can be established.

The northern end of Caledonia County, containing as it does much of the lighter, sandy soils, is showing the effects of overgrazing on many of the sidehill pastures. Had these pastures been fed fertilizer minerals, particularly potash and phosphorus, and rotated and managed so as to eliminate the effects of overgrazing, they would still be providing good pasturage. The pictures accompanying this article show an area in one of the good agricultural towns and on a main highway, where typical erosion has been taking place. They could have told a much different story had something been done about it a very few years ago. With cows grazing 100 pounds of grass per day or better, the large amount of plant food taken out should have been replaced. There is no other way to do it except through fertilizers or barnyard manure, and most of the latter is necessary for crop and hay land.

**This pasture provided good grazing for a large dairy herd 15 years ago. But overgrazing, without plant food being returned, has resulted in the sod becoming so thin that serious erosion is taking place. It now provides little more than an exercise ground.**

The Agricultural Conservation Program now completing its fifth year in the state and county, and enthusiastically going into its sixth, has formed a very sound base from which to work for better hay and pasture land. It started in 1936 with some 660 farmers signing up, 579 of these completed the practices. The year 1940 showed 1,222 signed up with a 96 per cent completion, taking in approximately all the farms being operated as such in the county. At the present time, nearly $100,000 in cash and materials in lieu of cash are coming into the farmers' pockets and the farmers' fields annually. Discounting the fact that the payment received is undoubtedly an incentive and a great help in carrying out the practices, the actual value in replacing soil fertility is and will be immeasurable as the years go by.

For years extension agents worked hard to get across in an educational way the story of better hay and better pastures. Many meetings were held and hundreds of demonstrations with various fertilizer strengths and rates of application were made, yet the actual

progress was slow. Farmers would come to the demonstrations, see the results, comment favorably, and plan on trying it out on their own farms, but not until the conservation program got under way and sizable amounts were ordered and tried was there much actual response.

It is certainly safe to say that 5 years of agricultural conservation work in Caledonia County and probably in the State of Vermont as a whole, have seen more accomplishment for better hay and pastures than the previous 15 or 20 years of extension education in this line. A sound agricultural conservation program operated by farmers and guided through the State and County offices, along with a sound land use program also built and guided by the farmers and extension workers, has every chance of giving farmers a forage-crop and pasture program of real value for the years that lie ahead.

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# Corncrib Loyalty

(*From page* 5)

This, however, is likely to follow if the extra investment and accumulated risk penalize farmers who lack the thoughtful consideration of their customers. It might in time mean consolidated farm holdings, corporation estates, more day labor and less responsibility, with a declining zest for liberty and fraternity. Real monopolies in producing food might arise, to add to those in distributing it, and real regimentation of consumers would be in sight. Soils would undergo a fresh wave of neglect for a few years and fortunes from private and public funds would be needed to replenish them.

It seems sounder to pay the farmer a decent going return during the interval of a wartime boom than to thwart his necessity and push him into a series of tailspins that only repeat the sins and errors of the old lamented post-war period.

But right here comes the remarkable twist to this problem. Our corn-belters are going to keep right on stretching their strides and wearing their overalls to a frazzle trying to fill the food list that Uncle Sam and the newly employed have put up to them. They won't balk or lag and shrug their shoulders, sniveling about long hours and having to hire some no-account harvest hand. I've been out on the front where the corn fritters and bacon originate, and take it from me, an old-timer, you won't hear anybody threaten to quit, price or no price.

Most of them are so relieved over dropping the custom which labor and industry taught them—cutting down production—that they are boiling over with ardor to spill out the whole cornucopia of nature's largess. Meanwhile they keep a shrewd eye on the soil balance, which is something they forgot in the former fracas, and the restitution of which was the major task of the nineteen thirties.

Corn-belt sows are doubling up on parturition; worm capsules are being bought by the ton; skim-milk and tankage is being dished out like a longshoremen's banquet; and there are more young grunters in the rape and bluegrass than you would find in an Irishman's happiest dreams.

Wool growers are stuffing sacks like a giant's mattress; tying the separate fleeces with hard twine and grading out the stains and tag-ends; flushing the ewes and docking the lambs in the greatest revival of shepherding since the spinning days of the pioneers.

Adolescent roosters are no longer a drug on the market because the renewed cry for a chicken in every pot is boosting broilers. All the farm women I know and as many of their husbands as can be persuaded are

clucking around with messes of baby chicks and infant ducks. Attics, garage floors, and woodsheds are being converted into colony houses, and even cabin trailers are not being overlooked. This expansion carries less hazard than the expansion of larger livestock and poultry matures in a hurry for ready cash. There may be a surplus at times, but it won't fret the farmers much out our way, since they have to feed parish parsons and city cousins sometimes and the wishbones won't be wasted.

When it comes to expanding concentrated protein into convenient packages for overseas shipment, there's where the milk producers get their assignment. The tardy old bureaucrats finally got around to issuing an SOS to the silo fillers, and honestly, instead of a few extra strippings the cows ladled out an inundation. We've seldom had grass so green and luscious, clover so aromatic or alfalfa so noodled with nitrogen. It's so lactic in the Midwest dairy country that the cows milk twice as much night and morning, and we expect to run stainless steel pipelines from the pastures for noonday relief. Cheese and canned milk are the favored articles, and before summer is over the haulers will be draining the butter belt for delivery to the vats and condensers.

OF course, the cow-milking gentry had to get in a few pow-wows about prices and privileges before they admitted that it's paying them well to squat on the milk stool a little longer. That's natural behavior for them, as I have reported to you on sundry occasions in these weighty columns.

For be it known that the lacteal lads always shy at anything which smacks of federal coercion, except fixing milk price orders of their own choosing or taking a slam-bang at the oleo outfit. Organized milkers put the double X on the triple A years ago because all the legal talent in Philly plus the Supreme Court and the Harvard Law School couldn't figure out an adjustment program for the bovines, up, down, or sideways. More brains and bluster have been exerted at endless chatterfests to round up a scheme that would get an encore from the udder tuggers, but it's been one vacant void and a racking headache from Utica to Pasadena.

Hence this open call for more of everything sanitary coming from the cow barn has sent the bosses of the bossies into a panic of ration balancing and teat massaging. We are happy to print herewith that the dairymen and the government see through one periscope at last, and can shake hands without boxing gloves on. Having won support of the reluctant and independent dairy battalion, we can say that the worst fears of a bucolic revolution in the Midwest are over.

THERE'S one thing I'll admit, and that is we are not very warlike out in the sticks. We are not crazy to smell anybody's powder, our's or the other guy's; but we are not averse to snuffing up a batch of cultivator dust or thresher chaff. Our modern tractors suit us almost as well as tanks, as we can go 15 miles an hour and run over gardens and chickens without a qualm. We prefer to operate the dirty orchard pump shooting bugs with lead arsenate rather than start training with a gas machine. Some of our 1920 farm trucks made as much noise as antiaircraft batteries, and the straw boss can holler louder and act uglier than a top sergeant. We've got the feel of a battle zone anyway, and about as much night's rest as a front-line trooper, so if you need any dirty work at the crossroads call on us.

But we like to rest a spell in the shade at lunch time, fanning our brows with the latest war news, and renewing our faith in each other and the rest of America. So if you'll pause awhile with us beside the stubble field, we can show you a bubbling spring, ice-cold and pure, and we can dip you a brimming cup of nature's nectar and toast you all to the United States of America and its citizens and Commander. The Soil Squad salutes!

Little Jim, "Daddy, a man's wife is his better half, isn't she?"

Father, "Well, son, they are frequently referred to as such."

Little Jim, "Then if a man married twice, there wouldn't be much of him left, would there?"

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SURPRISE

The farmer's wife had been pestering him for a long time to buy some new clothes. So one day, when he drove to market, he decided to surprise her. He purchased an entire new outfit, which was packed and placed under the buggy seat. Driving home, he had to ford a river and here he paused, took off his clothes, bathed in the river and then tied all his old garments to a rock and threw them into the stream. Reaching under the seat for his new clothes, he was horrified to discover that they weren't there. After a frantic but unavailing search came a pause for meditation. Then he climbed briskly into the buggy, touched up the old horse with the whip, and said, "Giddap, Mariah, we'll surprise her anyway."

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*They're picking up the pieces*
*With a dustpan and a rake,*
*Because he grabbed a silken knee*
*When he should have grabbed the brake.*

---

One broiling July day an aged "cullard gemman" who was pushing a barrow of bricks paused to dash the sweat from his dusky brow; then, shaking his fist at the sun, he apostrophized it thus: "Fo' the Lawd's sake, whar wuz yuh last Janooary?"

ALSO RAN

"Am I the only girl you've ever kissed?" demanded the pert young thing.

"Well—er—no," blurted her latest find, "but—"

"Then buzz off," was the reply. "If you know the course, and that's your top form, I'm not playing."

---

*Mrs. Jones* (at seashore)—"My husband writes that he's feeling good, business is good, and he loves me."

*Mrs. Smith*—"All on that little scrap of paper?"

*Mrs. Jones*—"Yes, it's a check for $100."

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"You say you want me to give you a divorce from this woman?"

"Yassuh."

"But you've been married nineteen years."

"Yassuh, Ah jes' don' want to get in no rut."

---

A small boy leading a donkey passed by an army camp. A couple of soldiers thought they would tease the lad.

"What are you holding onto your brother so tight for?" asked one of the soldiers.

"So's he won't enlist in the army," replied the boy without blinking.

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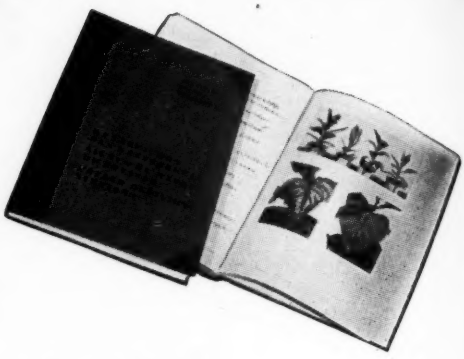
AND—

If the U. S. Navy gets much bigger, there won't be enough girls in every port to go around.

# POTASH DEFICIENCY SYMPTOMS



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